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**UNITED FRUIT COMPANY**

*General Offices: Boston, Massachusetts*

**MEDICAL DEPARTMENT**

**EIGHTEENTH  
ANNUAL REPORT**



**1929**

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July 1st, 1930.

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# UNITED FRUIT COMPANY

*General Offices: Boston, Massachusetts*

## MEDICAL DEPARTMENT

### EIGHTEENTH ANNUAL REPORT



1929

*Made in United States of America*



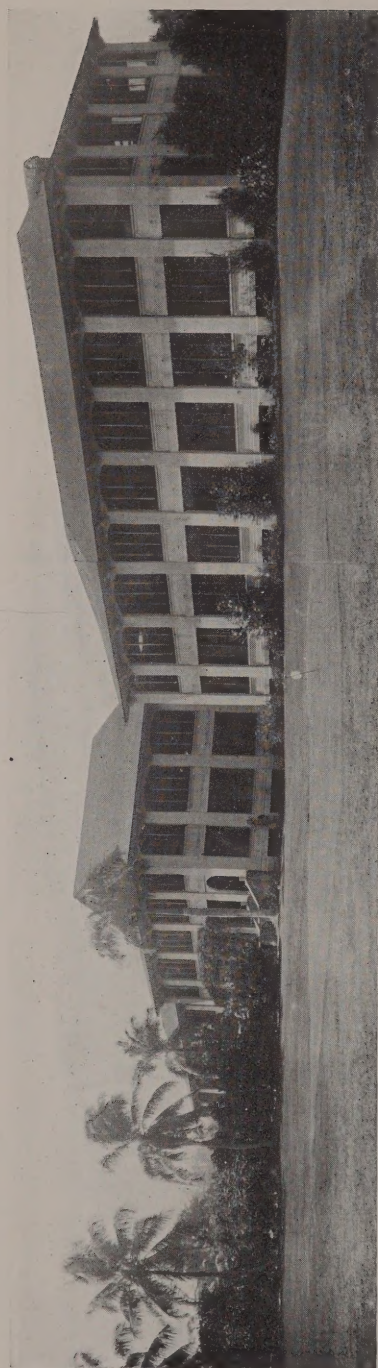
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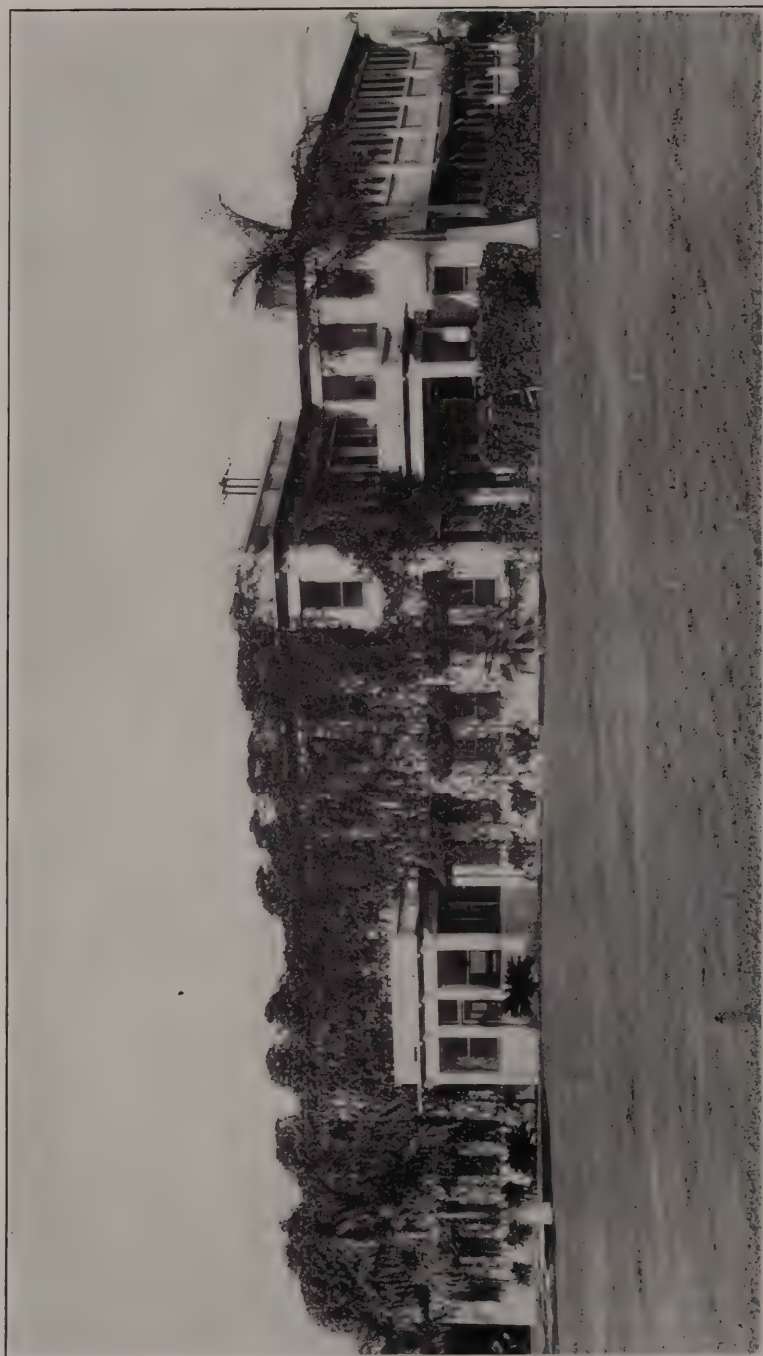


#### TRUXILLO RAILROAD COMPANY HOSPITAL STAFF

Front row (seated) left to right: J. A. Lopez (Physician), W. E. Muldoon (Oculist), B. M. Phelps (Sup't and Chief Surgeon), G. H. Robertson (Chief Nurse and Matron), and B. Statham (Chief Clerk).

Back row (standing) left to right: W. R. Tennyson (Dispenser), Twila Phillips (Nurse), Maria Curbelo (Nurse), Americal Ferrera (Nurse), Sylvia Haylook (Nurse), Henrique Hernandez (Ass't Laboratory Technician), Francisco Quinonez (Anesthetist and Dresser), Rafael Ferrera (Clerk), and Genaro Sarrío (Office Boy).





UNITED FRUIT COMPANY HOSPITAL AT PRESTON, CUBA



UNITED FRUIT COMPANY HOSPITAL AT BANES, CUBA





CHIRQUI LAND COMPANY HOSPITAL AT PUERTO ARMUELLES, PANAMA. (FRONT VIEW)  
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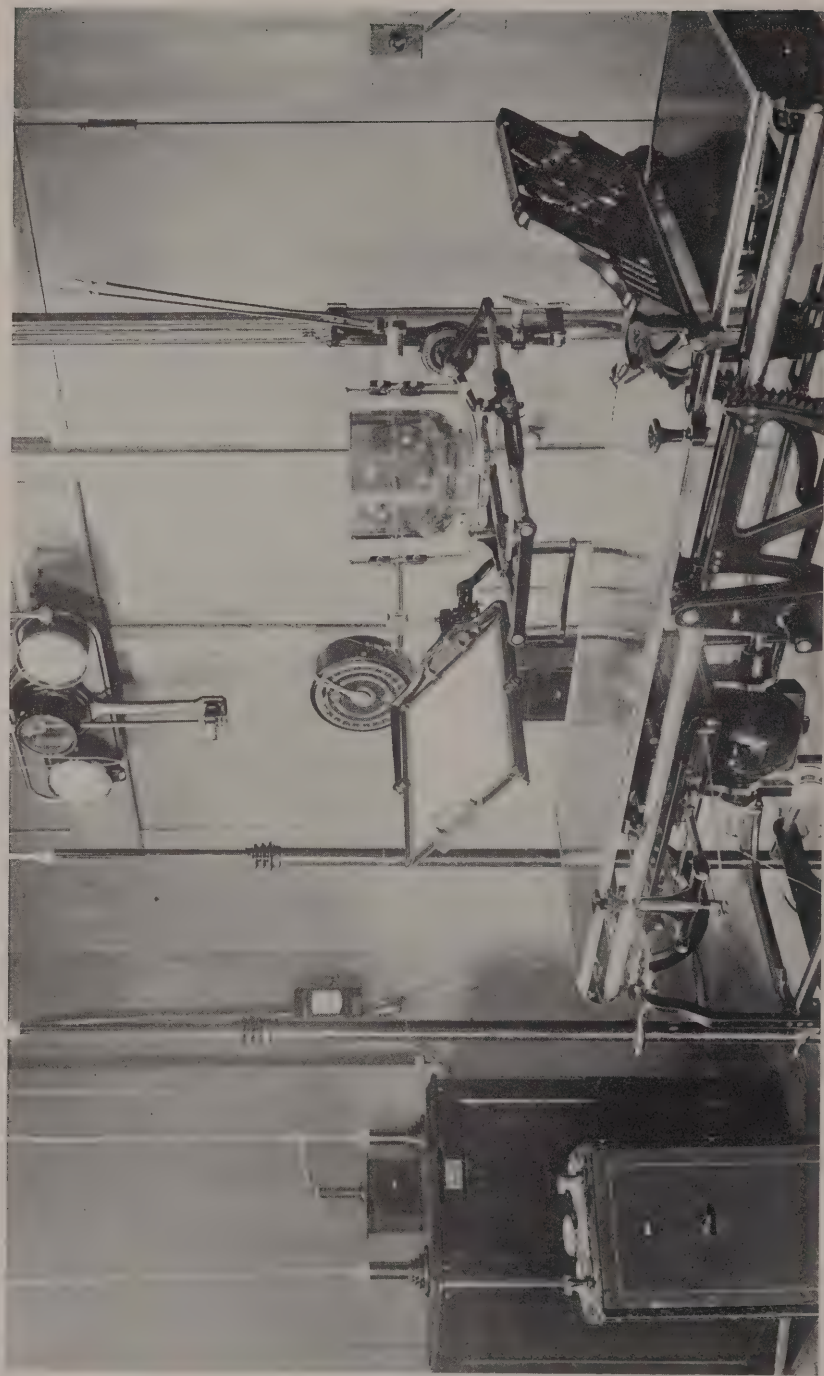


VIEW OF KITCHEN IN CHIRIQUI LAND COMPANY HOSPITAL, PUERTO ARMUELLES, PANAMA



VIEW OF WARD WITHOUT FURNISHINGS IN CHIRIQUI LAND COMPANY HOSPITAL, AT PUERTO ARMUELLES,  
PANAMA



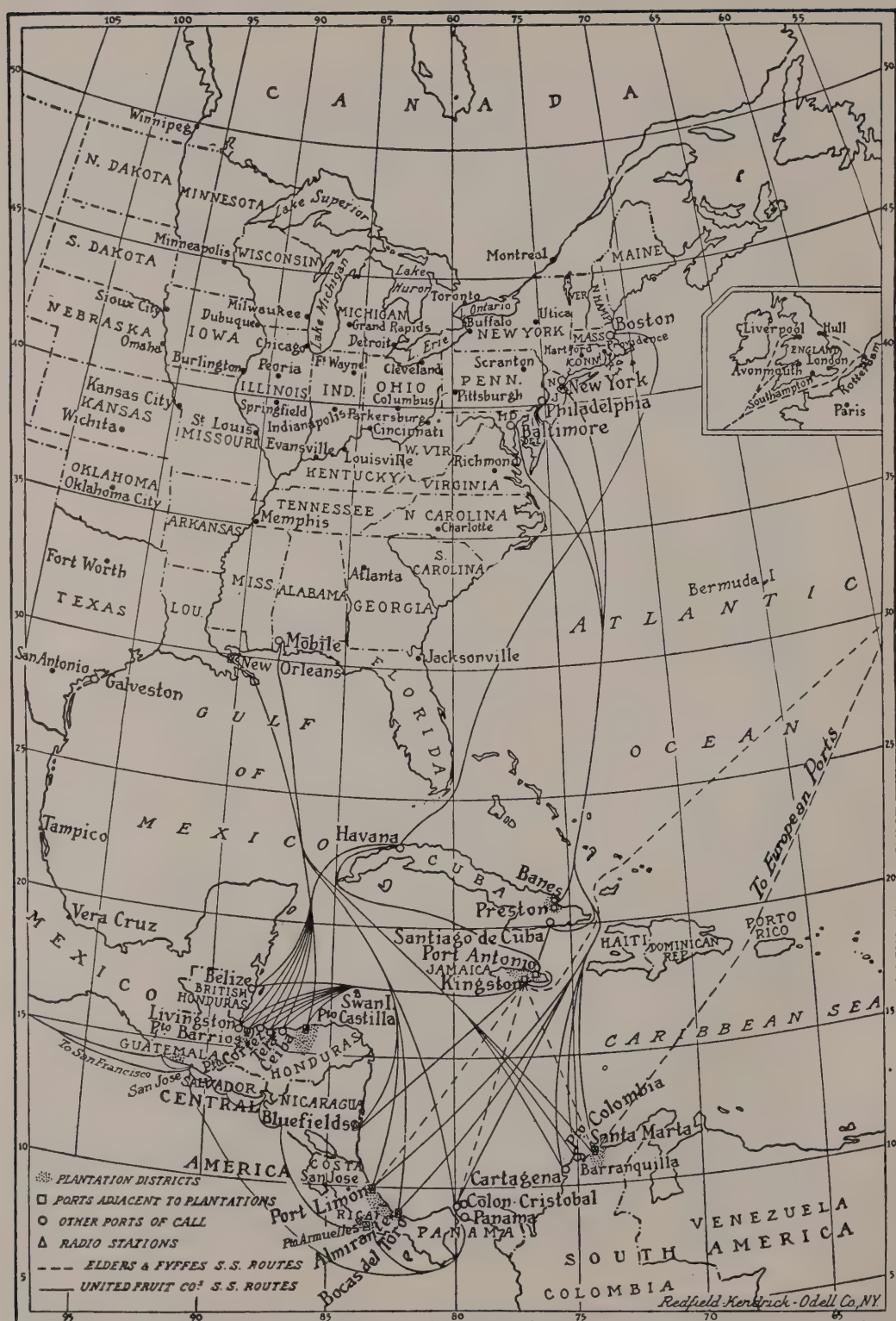


X-RAY UNIT IN THE UNITED FRUIT COMPANY HOSPITAL, PRESTON, CUBA



DENTAL PARLOR AT CENTRAL PRESTON, ORIENTE, CUBA





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## SECTION I

# UNITED FRUIT COMPANY

May 1, 1930

MR. V. M. CUTTER, President  
United Fruit Company  
Boston, Massachusetts

Dear Sir:—

The Annual Report of the Medical Department of the United Fruit Company for the fiscal year ended December 31, 1929, is herewith submitted:

Some changes have taken place in the personnel of the Medical Department during the past year.

For administrative purposes the 2 hospitals in Cuba have been consolidated, with Dr. Jaime de la Guardia as Medical Superintendent and Dr. P. S. Malaret (Jr.) as his assistant.

We regret to announce the retirement of Dr. J. R. Ariza from his position as Medical Superintendent of the Banes Division after 28 years of active service. It is gratifying, however, to be able to state that he has consented to retain a connection with the Department in a consulting capacity.

We regret, also, to announce the resignation of Dr. K. P. A. Taylor, in order to enter private practice in Havana.

Dr. Ignacio E. Peon, who has been in the medical service for about 8 years, has also severed his connection with the Company.

These resignations have necessitated several inter-divisional transfers among other members of the staff.

The interest in the program for the control of malaria is still maintained and further progress reported as shown in Table I on page 103.

In this connection your attention is invited to the report of Dr. Eugene R. Whitmore's research work on Plasmochin in the Truxillo Railroad Company Division, which appears on page 37 of this Report. His work confirms largely that of Dr. M. A. Barber, W. H. W. Komp and B. M. Newman, members of the U. S. P. H. S., which was described in detail in the 1928 Annual Report.

This research work leads to the conclusion that in plasmochin we have a drug which, when administered in small doses to patients suffering from malaria, prevents mosquito infection, thus forging the last link in the chain of measures necessary for malaria control.

Smallpox or alastrim (a mild clinical form of smallpox) appeared in epidemic

form on the Isthmus of Panama, and threatened invasion of the nearby plantations in Almirante, Chiriqui Land Company, Costa Rica and Colombia. Immediate precautions were taken, numerous vaccinations made, and during the year only 1 case (in the Colombia Division) was reported from our plantations.

Seven cases of leprosy were treated in the hospitals—3 employees and 4 non-employees.

No other quarantinable disease was reported as occurring in any of the Divisions or aboard the steamships.

The hospital in the Chiriqui Land Company Division is now completed and occupied.

In addition to the research work of Dr. Whitmore mentioned above, which was done in the Truxillo Railroad Company hospital, Dr. Andrew Robertson of the London School of Hygiene and Tropical Medicine spent about 3 months in the hospital of the Tela Railroad Company investigating some problems in Protozoology, and has contributed an interesting paper for this report.

W. H. W. Komp (U. S. P. H. S.) again made a malaria survey in some camps of the Almirante Division and later on in the Chiriqui Land Company Division. His report appears on pages 65 to 71. In both of these Divisions he also made cross-section surveys for the presence of trypanosomes in horses and mules, but with negative results.

Dr. H. C. Clark still maintains his interest in the Medical Department in a consulting capacity, and we are indebted to him for contributions to this Report on subjects allied to our own work.

Dr. W. M. James of the Herrick Clinic, Panama, who is also on our Consulting Staff, has submitted for publication an important article entitled "Do We See Gout in the Tropics?" Dr. Tomas Guardia, who is likewise a member of the Herrick Clinic, has sent us a paper entitled "A Study of 980 Chemical Analyses of the Blood, With Special Reference to Hyperuricemia." Furthermore, we are indebted to Dr. James for a comprehensive review of a recent publication by Sir Leonard Rogers which is a distinguished contribution to medical literature.

Dr. F. W. O'Connor, Associate Professor of Medicine in Charge of Tropical Diseases at the Columbia School of Tropical Medicine, has kindly reviewed books published by Dr. Hegner and Dr. Taliaferro, both of whom in the past have done research work in the hospitals of the United Fruit Company. These reviews appear on pages 355 to 357.

The increasing interest shown by members of our staff in their work is evidenced by the large number of papers contributed by them in this Report.

The Medical Department desires to express its gratitude to the officials of the United Fruit Company for their sustained coöperation and support.

Respectfully,

*W. Weeks*

# COMMENTS ON SOME OF THE MORE IMPORTANT DISEASES OCCURRING IN THE TROPICAL DIVISIONS

During the year 1929, the Medical Department furnished care in the Tropics to 68,965 employees and 102,256 non-employees.

The statistical data, tabulated at the end of this Report, give in detail the incidence and fatality rates of the various diseases encountered.

## MALARIA

It will be noted that malaria is responsible for the greatest percentage of morbidity, but that the fatality rate is low. Owing, however, to its prevalence, chronicity and debilitating effects on the population, malaria still must be considered as the disease of outstanding economic importance in the Tropics.

In 1926 an intensive campaign for malaria control was inaugurated and the progress made has been encouraging. The number of cases hospitalized has been greatly reduced, and also the incidence of the disease, as determined by malaria surveys. Detailed reports on different phases of the control work appear in Section II.

The effects of the campaign on the laboring population are reflected in a few abstracts from letters of Farm Superintendents (directly in charge of labor units) which are quoted below:

Due to the improved camp sanitation conditions and the anti-malarial campaign many favorable results have been noticed such as less sickness in the camps, a healthier and better contented class of labor, and an increase in the amount of money earned in many instances. I show below table of earnings per man for the past three years in one district.

	1927	1928	1929
Average earnings per man for month . . .	\$30.79	\$38.61	\$40.80

We on the farms have tried to get in touch with every individual, finding out his ailments if any. At first the laborers were very backward, making treatment difficult. By continually working with them they soon learned the benefit they were deriving. As it is now they ask for quinine at the first sign of fever. By making the daily camp inspection, which is done on all the farms, people with fever are treated there and those that do not respond are sent either to the dispensary or hospital.

The results are very gratifying. We have obtained more working days per man, more stability, and better contentment among them. We have numbers of men coming into the District from outside who already have fever. They are, as much as possible, treated at once, thereby preventing more people from being infected.

. . . . .

The greatest improvement is shown in the children that one sees in the Camps. Even as late as last year, the general appearance of the children was poor, sore eyes and general poor condition. Today there is very little of this and the majority have a healthy look.



As regards the attitude of the labor towards this campaign—at first it was almost antagonistic; then quizzical. Then gradually, when the results on some cases were noted, conversion started. Some cases were very grateful, and converted others; and so the belief in the efficacy of the campaign gradually gained ground, until now nearly every one is a convert, and they now realize that this campaign had something in it after all—and moreover, something for their own good.

Statistics show that the campaign has lowered the percentage of positive bloods in the camps year by year, and that alone is enough in its favor to justify it, for less malaria means lower overhead, a steadier continuity of farm work, and greater satisfaction among the people themselves.

My opinion is that our sanitary measures have helped to stabilize labor and increase their ability to perform work—with the result that we are getting a given unit of work done with less men. While it is difficult to present figures which would substantiate this assertion yet I may point out that during recent years with little or no influx of labor we have not experienced the recurrent shortages of labor that used to occur in previous years.

#### PNEUMONIA

*Lobar Pneumonia.*—The following table shows the incidence of cases of lobar pneumonia treated in the hospitals from 1926 to 1929 inclusive, the fatality rate and the total number of deaths in the hospitals from all causes:

	Cases	Deaths	Percentage	Total Deaths All Causes
1926	442	124	28.1	737
1927	329	108	32.8	765
1928	368	138	37.5	739
1929	324	95	29.3	797

The Chiriqui Land Company data are included in the 1929 statistics and not in those of previous years.

The incidence varies little from year to year, and the fatality rate is high for reasons detailed in previous Annual Reports. The underlying causes are difficult or impossible to control.

*Unspecified Pneumonia.*—Other cases of pneumonia not specified as to character numbered 18, with 9 deaths. In 1928 the corresponding figures were 33 and 7.

*Bronchopneumonia (Including Capillary Bronchitis).*—Under this classification are listed 127 cases, with 33 deaths. In 1928 the corresponding figures were 130 and 31.

#### TUBERCULOSIS OF THE RESPIRATORY SYSTEM

In 1929, 380 cases were admitted, and among these 59 deaths occurred in the hospitals. The corresponding figures in 1928 were 251 and 36.

Many cases suffering from tuberculosis are repatriated or referred to colder climates for treatment, and the recorded deaths in the hospitals do not indicate the fatality rates.

Tuberculosis affecting other tissues of the body—skin, bones, meninges, intestines, joints, lymphatic glands, etc., including acute miliary, were 33 as against 32 in 1928.

### INFLUENZA

In 1929, 1,376 cases of influenza and its complications were admitted to the hospitals, mainly from the Colombia, Costa Rica, Guatemala and Honduras Divisions. From the Tela Railroad Company Division alone, 632 cases were recorded.

The cases were comparatively mild as only 7 deaths occurred and these were due to secondary pneumonia. In 1928, 1,755 cases were recorded, with 11 deaths—10 from secondary pneumonia and 1 from heart disease.

### TYPHOID FEVER

In 1929, 106 cases of typhoid fever were treated in the hospitals—53 employees and 53 non-employees—and 18 died—8 employees and 10 non-employees; also 18 cases of paratyphoid fever—9 employees and 9 non-employees, of whom 2 employees died. The 1928 figures were 78 cases of typhoid, with 12 deaths; and 22 cases of paratyphoid, with 2 deaths. In the Banes Division 40 of the typhoid and 3 of the paratyphoid cases occurred, and of these 28 were non-employees.

In none of the Divisions have we been able to incriminate a common source of infection in water, milk or other food supplies. The cases occur sporadically. Apparently carriers introduce the infection, which is spread by means of flies or through food or drink channels. Protective vaccination of contacts is the system employed to prevent its spread.

### AMEBIC DYSENTERY

In 1929, 325 cases of this disease were treated in the hospitals—224 employees and 101 non-employees; and the fatalities were respectively 2 and 4. In 1928, 331 cases were treated—249 employees and 82 non-employees, with 3 fatalities—1 employee and 2 non-employees.

The incidence was low in both the Cuban and the Panaman Divisions, but much higher in the others.

### BACILLARY DYSENTERY

Only 30 cases were recorded in 1929, with 2 deaths. The corresponding figures in 1928 were 82, with 8 deaths.

In addition, there were 130 cases of dysentery unspecified as to character, with 5 deaths. The corresponding figures in 1928 were 99 cases, with 5 deaths.

There has been no change in the method of treatment of any form of dysentery during the past year. These have been fully discussed in former Annual Reports.

## BERIBERI

In 1929, 68 cases were treated in the hospitals, and only 42 cases in 1928. In both years the incidence was high in 3 Divisions—Preston, Colombia and the Truxillo Railroad Company, where it has been more difficult to obtain ample supplies of green vegetables than in the other Divisions. This condition in the Preston Division is discussed by Dr. de los Reyes on page 138 of this Report. It will be noted that with the increased supply of green vegetables the incidence of the disease immediately subsided.

## HOOKWORM DISEASE

As a primary diagnosis, 566 cases were recorded in 1929, with no deaths; in 1928, 419 cases, also with no deaths.

This disease must be considered in the United Fruit Company plantations only as a contributory factor in the prevailing anemia among the native population, but not of primary importance in interfering with economic conditions.

Its incidence is high, but the degree of infection generally light. In all hospitalized cases routine examinations are made; and, if ova are found, treatments given.

## DIPHTHERIA

Only 13 cases were reported in 1929, and of these 12 were non-employees. Eight of the cases occurred in the Banes Division. There were no deaths. In 1928, 17 cases were recorded, of which 14 were non-employees; and 2 died. Diphtheria apparently does not assume epidemic proportions in the Tropics. The cases generally are mild, and deaths rarely occur.

## VENEREAL DISEASES

*Syphilis*.—In 1929, 795 cases of syphilis in all stages were treated in the hospitals, and 15 deaths recorded. Correspondingly in 1928, 901 cases were treated, and also 15 deaths occurred.

As many of these require prolonged periods of hospitalization, their growing economic importance is becoming a matter of serious concern.

*Soft Chancres*.—In 1929, 284 cases with soft chancres were treated in the hospitals; in 1928, 172 cases.

*Gonorrheal Infection*.—In 1929, 562 cases required hospitalization; in 1928, 549 cases.

In 1929, 13 cases of gonorrheal ophthalmia were hospitalized; in 1928, 6 cases.

These records do not by any means indicate the incidence of venereal diseases, as only the more serious cases are hospitalized and the vast majority are treated as ambulatory cases in the dispensaries.

W. E. DEEKS.



## SECTION II

## TREATMENT OF MALARIA

N. P. MACPHAIL, M.D.

United Fruit Company Hospital  
Quirigua, Guatemala

With the passing of yellow fever and the reduction of the incidence of amoebic infection to about the vanishing point, malaria is the most important preventable disease with which employers of labor have to deal in this section of the Central American Tropics. It causes more morbidity among the native populations, with consequent loss of labor days, than any other disease.

The most satisfactory methods of treating acute and chronic cases of malaria have long been, and still remain, matters of discussion.

The writer has had over 20 years clinical experience in a highly malarious community, where he has had excellent opportunities of seeing large numbers of practically every form of the disease, and has been concerned in the treatment and management of the various manifestations encountered. He considers it possible that a brief description of the measures found most satisfactory here might be worthy of record, and might prove of assistance to younger men similarly situated.

In this locality from 70 to 80% of the cases encountered are of the estivo-autumnal type, which gives an opportunity of seeing more pernicious forms of the disease than are observed in communities where the benign forms of the disease prevail.

To find the most satisfactory routine measures, for use in the vast majority of hospital cases of all forms of malaria, has been one of the problems which received earnest attention. The routine finally adopted in this Hospital, and which gives as complete satisfaction as any routine can be expected to give, is a preliminary dose of calomel and soda (3 to 5 grains—according to the size and condition of the adult patient), administered with 15 grains of quinine and followed in 4 hours with a dose (1 to 2 ounces) of magnesium sulphate in solution. The most satisfactory preparation of quinine for general use, which we have found, is the soluble friable tablet of the sulphate; but the solution of quinine sulphate is also satisfactory. After the preliminary purge and accompanying dose of 15 grains of quinine, the routine consists of 15 grains morning and evening, given concurrently with 1 tablet of plasmochin compound (0.01 gram plasmochin, with 0.125 gram quinine sulphate) each morning and 2 tablets of plasmochin compound each evening for 6 full days. The plasmochin is then discontinued.

If the patient has had several days of fever, a second dose of salts is adminis-

tered on the 3rd or 4th day to assist in eliminating the toxins. This assists in restoring the appetite; and, when it returns, a generous well-balanced diet is given.

After the 6th day, 1 or 2 Pink Tonic Tablets are given twice daily; and the quinine is reduced to 10 grains twice daily, unless the patient has had a secondary rise in temperature or is suffering from an unusually heavy infection. The formula used in the preparation of this tablet is as follows: Quinine sulphate, 2 gr.; acid arsenous,  $\frac{1}{50}$  gr.; ext. nux vomica,  $\frac{1}{8}$  gr.; reduced iron,  $\frac{3}{4}$  gr. These tablets have proved to be an excellent tonic, helping to restore the appetite and to hasten convalescence.

When the patient is discharged from the Hospital, in the post-febrile period, he is provided with a supply of these tablets, and is encouraged to take 2 tablets 3 times daily for 2 or 3 weeks. Patients need little persuasion to do so; although they frequently have a cordial dislike for quinine, and can not be trusted to take it without direct supervision.

Since the introduction of plasmochin, this drug, combined with quinine, has been given for from 4 to 6 days to all malaria cases. Its chief value consists in devitalizing the gametocytes and clearing them from the peripheral blood in a few days, which quinine fails to do. Barber and Komp, and Whitmore believe that a single dose of from 1 to 2 centigrams of plasmochin, devitalizes the gametocytes during the period of an acute attack; and so prevents mosquito infection.

It is the opinion of the writer that plasmochin has an influence in curing chronic cases; and that it assists in preventing relapses, particularly in the benign forms. Several cases of most intractable tertian malaria which I attended just prior to the introduction of plasmochin, whose relapses after long periods of quinine, arsenical, and tonic treatment proved cause for worry, cleared up completely after a thorough course of plasmochin. One particular case in a white employee who had recurring tertian malaria for 18 years, and who had taken many long periods of treatment with all known anti-malaria remedies without effecting freedom from relapses, is worthy of note. He contracted malaria in 1908, soon after coming to the Tropics. In the beginning, he took small amounts of quinine at irregular intervals; and, as each relapse occurred, he took short courses of quinine until the symptoms disappeared. Eventually the patient took long full-dose courses; but found that he suffered invariably from a relapse very shortly after he discontinued taking the quinine. Arsenic, and Warburg's tincture gave no better results. On several occasions, a change of climate, combined with lengthy courses of quinine and tonics was tried; but relapses occurred soon after discontinuing the medication.

When the first small supply of plasmochin was received, in 1926, this patient was under treatment for an acute tertian attack—one of his many relapses—and had about lost all hope of ever effecting a cure. He was given daily 12 centigrams of plasmochin compound, combined with quinine; and treatment continued for 6 days. On the morning of the 6th day he was cyanosed, and complained of

abdominal discomfort and pain in hepatic and splenic regions; but finished that day's treatment. The disagreeable symptoms gradually disappeared during the following day, and a tonic was administered for two weeks subsequently. No relapse has occurred since that time; and the patient has gained in weight, and remained in excellent health. On one occasion, he took 30 grains of quinine daily for 1 month and 20 grains daily for 5 succeeding months; and had a relapse a few weeks after he discontinued the course which was precipitated in this case by prolonged exposure in a cold rain storm.

Having personally supervised this patient's treatment in all his previous relapses, and knowing definitely that he faithfully took all medicines which were prescribed during his 18 years of treatment for malaria; I have little doubt but that the plasmochin deserves credit for his complete recovery.

There can be no doubt but that plasmochin devitalizes the gametes in a maximum of 6 days, with our present dosage—1 tablet of plasmochin compound (0.01 gram plasmochin, with 0.125 gram quinine sulphate) each morning and 2 tablets of plasmochin compound each evening for 6 full days—and probably in much less time; and thus offers a most valuable aid to the control of malaria. All hospital cases are now discharged with the assurance that their peripheral blood is free of gametocytes; while, in pre-plasmochin days, a large percentage of our hospital cases were clinically cured and feeling very well when they went back to labor camps, but were still harboring large numbers of gametocytes in their peripheral blood, and were in an excellent condition to infect mosquitoes.

In the early days of plasmochin administration the patients received 6, 8, and even 12, centigrams of plasmochin daily. A not infrequent result of such large doses was the development of gastric distress, nausea, and cyanosis. Suspension of the drug, in our experience, always resulted in a prompt cessation of these symptoms; but there are several cases on record of death resulting from an overdosage. No untoward results have been observed to follow the administration of the smaller doses now in use and given for 6 consecutive days; with the single exception of one individual, who seemed to have an idiosyncrasy for the drug. On two different occasions, on the 3rd day of treatment, he became cyanosed and suffered from gastric pains and nausea. Since the beginning of our present routine method of treatment, approximately 20,000 persons have received plasmochin in a similar dosage without showing symptoms of over-dosage; and it can therefore be concluded that this individual had a low degree of tolerance for the drug, as one occasionally sees in the case of quinine.

In our practice here, another drug which has become almost a routine in severe cases of malaria—especially when splenomegaly, or nausea and vomiting exist—is adrenalin chloride. It is administered hypodermically, in doses of 8 to 12 minims of a 1 in 1,000 solution; and preferably 15 to 20 minutes before quinine is given intramuscularly. In most cases it controls vomiting; and apparently forces parasites into the peripheral circulation, where the quinine probably comes easily and intimately in contact with them. I am firmly convinced that bene-



ficial results follow the use of this drug, and we have continued this practice, in individual severe cases, for many years.

Doctor Ricardo Aguilar, of this Hospital, has observed beneficial results from adrenalin in a large number of severe cases. He is very confident of its therapeutic value, and uses it in all severe cases.

When patients suffering from malaria seek treatment before the condition has become chronic, the physician can confidently expect a cure to result from the above mentioned routine method of treatment.

In general it may be stated that, in highly malarious countries, every individual not protected by well screened houses and offices at all times has or has had malaria. A large number of the so-called acute cases are relapses, which are likely to occur when people are subjected to any depressing influence such as exposure to heat or cold, fatigue, injury, etc.

This type of individual has developed some tolerance to the malaria organisms; and, although harboring them in his blood, his resistance takes care of them, and enables him to perform his daily duties under ordinary living and working conditions without a feverish condition developing.

When the natural defense agents are interfered with, and resistance lowered, the parasites often get the upper hand. These cases are readily restored to their former condition by the routine treatment referred to above; and, in many cases, it is now found that cures are effected. However, in such instances it is wise to prolong treatment. It is also important to treat complicating constitutional conditions, and insist on a good nutritious diet. The two latter necessities are frequently not stressed sufficiently in the treatment of chronic malaria. If tertiary syphilis is present as a secondary infection, iodides must be administered; if yaws, salvarsan; etc.; and focal infections must be treated. Furthermore, an ample, well-balanced diet helps to build up resistance which is necessary to effect a permanent cure.

The writer is convinced that the arsenical preparations have some value in chronic cases, though they are not necessarily a specific against the malaria organism. In chronic, relapsing tertian cases, stovarsol, arsphenamine, etc., have apparently been of service.

The routine treatments outlined in this article will cure the vast majority of estivo-autumnal cases, as well as those patients suffering from benign tertian and quartan infections. In a community such as ours, however, one sees many pernicious cases where more heroic measures are necessary to save life.

A very satisfactory routine has been adopted for the treatment of all such cases admitted; which is, however, subject to slight changes according to the symptoms and the general condition of the patient.

The algid type, which was formerly more common than now, requires adequate stimulation; application of hotwater bottles and blankets; and an intramuscular injection of  $7\frac{1}{2}$  grains of quinine, given as soon as possible after admission, and preceded by or in combination with a hypodermic of adrenalin solution. This is

repeated in 3 to 4-hour intervals, according to the severity of the case, until 45 grains have been given. The blood pressure in these cases is invariably low; and the alarming symptoms frequently induced by giving intravenous quinine led us to discontinue the intravenous method. This routine in algid malaria is very satisfactory; and as soon as the patient is in a condition to warrant it, the ordinary routine of plasmochin compound tablets and quinine by mouth is instituted.

Cerebral types of malaria are also frequently treated as above, with satisfactory results; but in this type a larger initial dose of 15 to  $22\frac{1}{2}$  grains is sometimes indicated, as the blood pressure is usually not so low, and the larger doses, accompanied or preceded by 8 to 12 minims of adrenalin solution (1:1,000), give good results. Ice-bags, applied to the head until consciousness returns, are useful. However, experience has indicated that (subsequent to the initial dose of 15 to  $22\frac{1}{2}$  grains) doses of  $7\frac{1}{2}$  grains, repeated at 4-hour intervals, until improvement is marked or until 60 grains have been administered, generally give more satisfactory results than the more heroic doses of  $22\frac{1}{2}$  grains, repeated at longer intervals, which was a former routine. Probably the release of larger amounts of toxins into the circulation, resulting from the more powerful action of large doses in destroying the parasites, accounts for the depression and occasional collapse which follow the administration of large doses of quinine in these serious cases.

We have not found that the usual objections advanced against intramuscular administration of quinine need be considered. When carefully given, with complete asepsis and careful massage, necrosis is practically unknown.

In the past 6 years, over 8,500 intramuscular injections of quinine have been given in the Hospital, and many thousands have also been administered in our field dispensaries. Abscesses have been rarely seen and occur, with certainty, in less than one-half of one per cent of the cases. Results prove that absorption is certain, and that it is a safe and valuable method of introducing quinine into the circulation.

This intramuscular routine is also followed in all cases of malaria, benign or pernicious, when vomiting prohibits the retention of quinine taken by the mouth. When vomiting has ceased, the patient is put on the regular oral routine.

## EFFICACY OF ROUTINE MALARIAL TREATMENT

B. M. PHELPS, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

A study of the efficaciousness of routine malarial treatment in a large number of cases, without interfering with economy of hospital operation, is difficult. Beginning July 1, 1929, it was decided to keep a card index of all laborers discharged with a diagnosis of malaria. This was continued until January 16, 1930, when the results were summed up.

*Routine Method of Hospital Treatment.*—The routine treatment observed in this hospital is as follows: A blood smear is taken immediately after admission, and all patients who present a history or show clinical symptoms of malaria, and who are able to take medicine by mouth, are at once given 3 grains of calomel and 15 grains of quinine sulphate. Most of our patients are admitted late in the afternoon, shortly after the arrival of the train from the outlying farm districts. The following morning quinine sulphate treatment is continued in doses of 15 grains b.i.d., and a solution of  $1\frac{1}{2}$  ounces of magnesium sulphate is administered early in the day. Patients who are comatose or who are vomiting receive their initial doses of quinine by injection—either intramuscularly or intravenously, depending on the gravity of the case. A full diet is permitted as soon as the patient expresses a desire for solid food. Laxatives are given whenever there is any sluggishness of the bowels. When the patient indicates that he is feeling entirely well (usually 3 or 4 days after the temperature has become normal), and when one or more thick films have been examined and found to be free from parasites, he is given 2 tablets of plasmochin compound (plasmochin 0.010 gram, quinine 0.125 gram) and is discharged as soon as a train is available to transport him to the locality from whence he came, which may be the following day or the second day thereafter.

*Routine Method of Follow-up Treatment.*—A record of these daily malarial discharges is sent to the official in charge of each outlying district; and such patients are put on the "Treatment List" to receive 10 grains of quinine sulphate daily for 2 weeks, or 2 Pink Tonic Tablets (each tablet contains quinine sulphate, 2 grs.; arsenous acid,  $\frac{1}{10}$  gr.; extract nux vomica,  $\frac{1}{8}$  gr.; reduced iron  $\frac{3}{4}$  gr.) twice daily for 30 days.

*Ratio of Relapses or Reinfections.*—During the period mentioned, 586 cases of malaria were registered on our card system. Of these, 37 cases had returned to the Hospital with relapses or reinfections, which is a readmission rate of about 6.3 per cent. Twenty-five of these cases had estivo-autumnal malaria on both admissions; 3 cases had estivo-autumnal malaria on the first admission and tertian malaria on readmission; 3 cases had tertian malaria on the first admission



and estivo-autumnal on readmission; 2 cases had estivo-autumnal malaria on the first admission and a mixed infection on readmission; and 1 case had a mixed infection on both admissions.

One patient was admitted on August 29, 1929, with estivo-autumnal malaria, and returned on January 7, 1930, with blackwater fever from which he recovered. One patient was admitted on August 25, 1929, with estivo-autumnal malaria; and was readmitted on November 27, 1929, with blackwater fever; and returned again on December 28, 1929, with an estivo-autumnal infection. One patient was admitted on August 13, 1929, and again on September 10, 1929, with estivo-autumnal malaria; and died later from causes not directly or indirectly associated with malaria. These 3 patients were residing in the same locality at the time of each admission; but 4 of the other 34 "repeaters," who were readmitted for malarial treatment during the period covered, had changed their residences between admissions.

*Factors Which Influenced the Data Recorded.*—There are various factors which partially vitiate the value of the figures shown above—e.g., (1) it is possible that many of the patients carried on our cards may still become "repeaters" within a very short period of time; and (2) there are definite reasons for believing that many of the discharged patients did not receive the routine follow-up treatment after leaving the Hospital.

*Summary.*—586 cases of malaria discharged from the Hospital between July 1, 1929, and January 16, 1930, were analysed to determine the relative number of relapses or reinfections. About 6.3% of these patients had been readmitted to the Hospital for treatment of the disease during this period.

*Conclusion.*—This simple routine treatment is economical, and appears to be fairly efficacious.

## THE ADMINISTRATION OF QUININE BY RECTUM IN THE TREATMENT OF MALARIA\*

K. P. A. TAYLOR, B.S., M.D.

United Fruit Company Hospital  
Quirigua, Guatemala

Difficulty in the oral administration of quinine is encountered in the following case types:

(1) Those who object to the disagreeably bitter taste experienced when 30 or more grains are taken daily over a period of several days. This taste is particularly noticeable in the early morning, and renders food unpalatable.

(2) Those whose gastro-intestinal tracts are unusually sensitive to quinine.

\* Originally published in the "*Southern Medical Journal*," May, 1930.

In some individuals of this group, irritation of the mucosa is so severe that vomiting, and even hematemesis, is produced.

(3) Those who are nauseated or vomiting from the true gastro-intestinal form of malaria. (In the American tropics, this group is of the greatest importance and the most frequent in incidence.)

(4) Unconscious patients; usually suffering from the algid and cerebral types of malaria.

(5) Individuals who are too ignorant, indolent, or prejudiced to persist long enough in the oral administration of quinine.

*Intravenous and Intramuscular Injection of Quinine.*—The dangers and disadvantages of these routes of administration are too well known to warrant discussion. Maxcy,<sup>1</sup> in a report collaborating with the special committee of the Council of Pharmacy and Chemistry of the American Medical Association,<sup>2</sup> has supported the view that the therapeutic action of quinine in malaria results not from direct contact of the drug upon malaria plasmodia, but rather through the medium of a metabolite, formed by quinine decomposition or alteration in the liver and capillaries. This committee confines its indications for the use of quinine intravenously to gastro-intestinal forms of malaria and to cerebral types. The necrotizing action of quinine alkaloids and salts upon tissue has been fully discussed by Dudgeon<sup>3</sup> and Fletcher.<sup>4</sup> Abscess formation, necrosis, severe secondary hemorrhage, fatal septicemia and sciatic nerve paralysis have been observed by the writer to follow intramuscular gluteal injection of quinine, and should relegate this mode of application to the most severe infections, vomiting cases, and unconscious and convulsive forms. Unfortunately, a large proportion of malaria cases applying for treatment in tropical America are of such severity that parenteral administration of quinine must be carried out, at least as an initial measure.

*Quinine by Rectum.*—A test of the rectal administration of quinine was decided upon, in the hope of finding a therapeutic method which would make unnecessary intravenous or intramuscular quinine injection in vomiting patients and cerebral types. Caution in selecting cases has not yet permitted a trial of the method in these case groups. The excellent results obtained in treating a small series (11) of mild and moderately severe cases of malaria by the rectal instillation of quinine, would seem to justify extending the trial of the method to more unfavorable cases.

*Past Experience.*—In the past many attempts have been made to effect routine rectal quinine administration; but the method has found little favor because of burning, irritation, tenesmus, and diarrhoea, and uncertainty as to the quantity of the drug absorbed.

Wilcox,<sup>5</sup> quoted by Ross<sup>6</sup> has estimated (clinically) that quinine administered by rectum is only half as effective as when given by mouth, and that both of these methods are inferior in point of effectiveness to the intramuscular and intravenous routes. Suzuki,<sup>7</sup> on the other hand, reported that the minimal lethal dose of

quinine administered by rectum to rabbits was 0.33 G. per kilogram, while by mouth it was 0.66 G. per kilogram. He habitually uses the rectal route in clinical practise, administering daily 100 c.c. of a  $\frac{1}{2}\%$  solution of quinine hydrochloride in water. The results reported by Suzuki from this small dose (0.5 G.) given daily by rectum, made a favorable comparison with cases treated by mouth. Generally speaking, they caused no "uncomfortable local disturbances."

It is clear that a daily dosage so small would not be effective in treating a majority of the malaria cases seen in native laborers of the Caribbean zone. Furthermore, larger quantities of quinine in watery solution have proven too irritating to the rectal mucosa. The technique devised by the writer and described below has permitted the exhibition of quinine by rectum in large dosage without discomfort to the patient or inability to retain the medicament.

*Effectiveness of Method.*—Infection by all varieties of malarial organisms as well as mixed infections have been successfully dealt with in this manner. No case has failed to respond to treatment, and in none has treatment been modified or supplemented by oral or parenteral administration of quinine excepting in those cases receiving an initial routine dose of quinine by mouth upon admission and before the establishment of definite diagnosis. Furthermore, clinical "cure," as well as elimination of parasites from the peripheral blood, has been accomplished as rapidly and as effectively as by oral administration.

#### CASE RECORDS\*

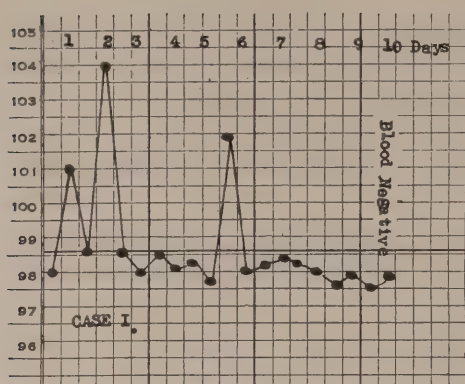
*Case I.*—Case No. 77, Quirigua Hospital, admitted 1-10-29, age 34, negro. Pain in back and left loin; condition fair. Blood smear positive quartan 0 + + +. Received 30 grains of quinine daily, by rectum, for 8 days. On 5th day, blood smear was quartan +. Second chill occurred the same day. Temperature, normal on 7th day. Blood, negative on 9th day. Discharged 1-20-29. Had not complained of tenesmus or irritation from treatment. All injections were retained.

*Case II.*—Case No. 398, Quirigua Hospital, admitted 3-4-29, age 35, native. Fever, chills and headache for 5 days. Condition fair. Spleen + +. Blood smear, tertian 0. Uncinaria ova in stool. Received 60 grains of quinine daily by rectum for 4 days. Temperature normal on 2nd day. Blood negative on 4th day. Discharged 3-9-29. No tenesmus. All injections retained.

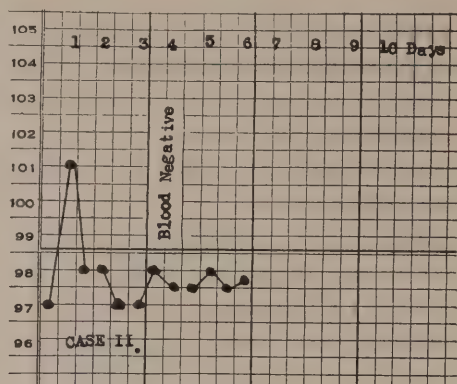
*Case III.*—Case No. 375, Quirigua Hospital, admitted 3-1-29, age 21, native. Fever for 20 days. Discharged 1 month previously, after treatment for cerebral malaria. (Blood negative on discharge.) Blood smear, tertian 0 + +. Received 60 grains of quinine daily by rectum for 6 days. Temperature, normal on 2nd day. Blood, negative on 7th day. Discharged 3-10-29. No tenesmus. All injections retained.

\* Ring forms are denoted 0; gametes C; marked infection +; heavy infection ++; severe infection +++; dangerous ++++. The designations are those of Mr. L. R. Mathews, Laboratory Technician, Quirigua Hospital, who made all blood examinations and reports as a part of the routine laboratory work.

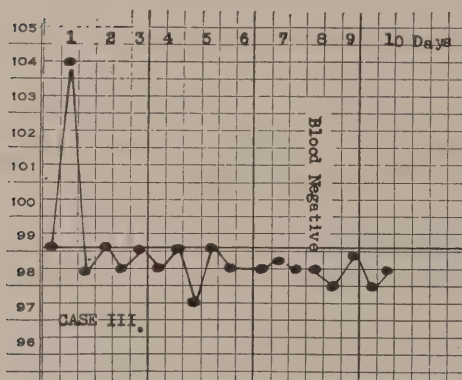




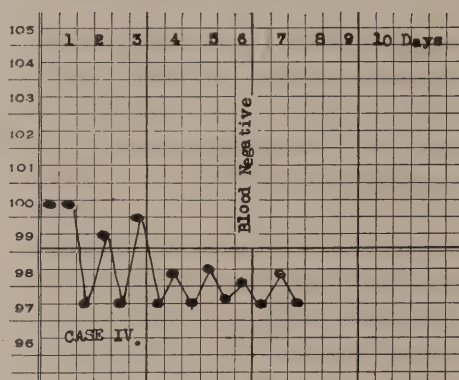
CASE I. QUARTAN 0 +++



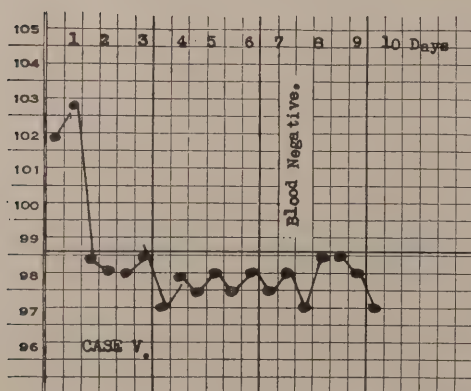
CASE II. TERTIAN 0



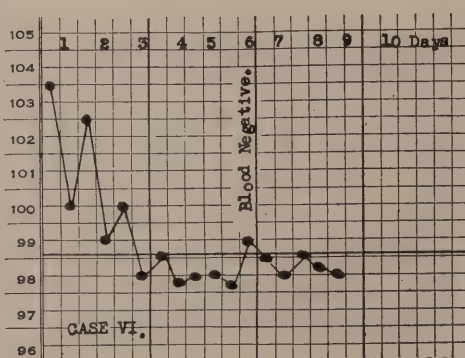
CASE III. TERTIAN 0 ++



CASE IV. TERTIAN 0 +++



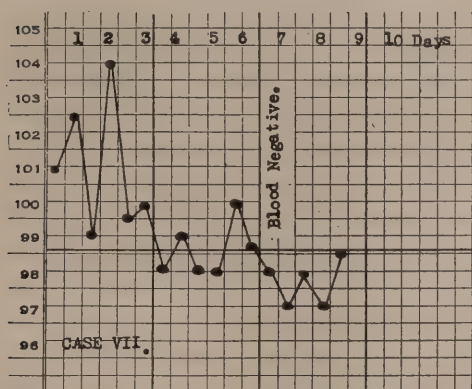
CASE V. ESTIVO-AUTUMNAL 0 +++ C



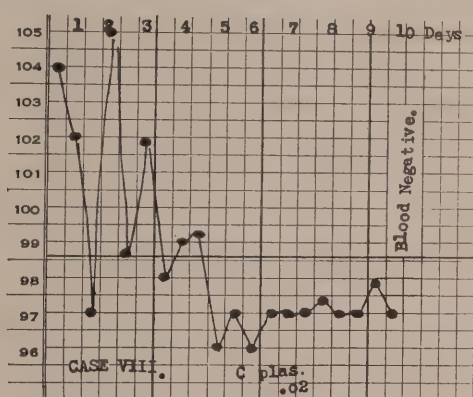
CASE VI. ESTIVO-AUTUMNAL C ++

*Case IV.*—Case No. 358, Quirigua Hospital, admitted 2-26-29, age 27, native. Headache, fever, pain in back and spleen for 4 days. Condition, fair. Blood smear tertian 0+++. Received 60 grains of quinine daily by rectum for 5 days. Temperature, normal on 3rd day. Blood, negative on 6th day. Discharged 3-5-29. No tenesmus. All injections retained.

*Case V.*—Case No. 134, Quirigua Hospital, admitted 1-23-29, age 20, native. Fever, chills and nausea for 2 days. Condition, fair. Blood smear estivo-autumnal 0+++ C. Received quinine 60 grs. daily by rectum for 7 days. Blood smear, 3rd day, E.A., 0+ C. Temperature, normal on 2nd day. Blood, negative on 6th day. Received course of plasmochin, after completing rectal injections. Discharged 2-3-29. No tenesmus. All injections retained.



CASE VII. ESTIVO-AUTUMNAL 0



CASE VIII. ESTIVO-AUTUMNAL 0

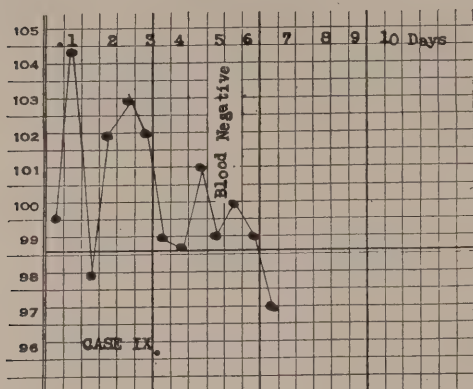
*Case VI.*—Case No. 269, Quirigua Hospital, admitted 2-11-29, age 24, native. Fever for 1 week. Condition, fair. Blood smear E.A., C+. Received quinine 60 grs. daily per rectum for 4 days. Temperature, normal on 3rd day. Blood, negative on 4th day. Put on "tonic tablets" and plasmochin. Operated upon for chancroid and inguinal adenitis 3-19-29. Discharged 4-7-29. No tenesmus. All injections retained.

*Case VII.*—Case No. 535, Quirigua Hospital, admitted 3-27-29, age 17, native. Fever and headache for 1 week. Condition, fair. Spleen, ++++. Blood smear E.A., 0. Received quinine 60 grs. daily by rectum for 2 days. Temperature normal and blood negative on 3rd day. Given course of quinine and plasmochin (os) for 6 days. Discharged 4-5-29. No tenesmus. All injections retained.

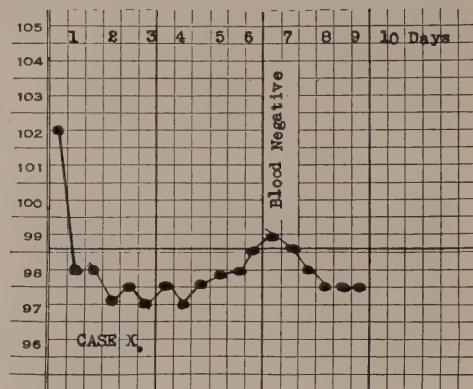
*Case VIII.*—Case No. 321, Quirigua Hospital, admitted 2-21-29, age 20, native. Fever, nausea, headache and pain in back for 4 days. Condition, fair. Spleen ++++. Blood smear E.A., 0. Received quinine 60 grs. daily by rectum for 6 days. Temperature normal on 4th day. Blood smear on 6th day E.A., C. Given 3 plasmochin tablets, 0.01 G. each, twice daily for 4 days. Blood smear

negative 3-3-29. Discharged same day. No tenesmus. Expelled greater part of second quinine injection.

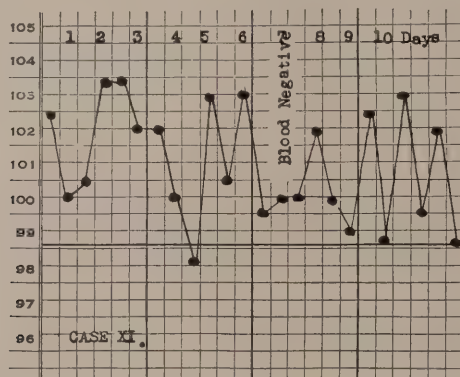
*Case IX.*—Case No. 52, Quirigua Hospital, admitted 1-7-29, age 18, native. Fever and headache for 4 days. Condition, fair. Blood smear, negative on admission. Blood smear second day E.A., 0. Received quinine 45 grs. daily by rectum for 6 days. Temperature, normal on 4th day. Blood smear negative



CASE IX. ESTIVO-AUTUMNAL 0



CASE X. ESTIVO-AUTUMNAL 0 +, TERTIAN 0 ++



CASE XI. ESTIVO-AUTUMNAL 0 +, TERTIAN 0 + + + +, MILIARY TUBERCULOSIS

on 5th day. Discharged 1-13-29. Complained of slight tenesmus for 2 days. Retained all injections.

*Case X.*—Case No. 133, Quirigua Hospital, admitted 1-23-29, age 25, native. Fever for 2 months and swelling of right side of neck. Blood smear, E.A., 0 +, Tert. 0 + +. Received quinine 60 grs. daily by rectum for 7 days. Temperature, normal on 2nd day. Blood smear on 3rd day E.A., 0, Tert. 0 +. Blood smear on 6th day, negative. Swelling of neck subsided on 3rd day. Quinine course followed by 2 tablets of plasmochin 0.01 G. each t.i.d. for 5 days. Discharged 2-3-29. No tenesmus. All injections retained.



*Case XI.*—Case No. 89, Quirigua Hospital, admitted 1-13-29, age 14, native. (Mixed infection of malaria and miliary tuberculosis.) Fever and cough for 6 days. Three previous admissions for cerebral malaria. Condition poor; stuporous. Râles throughout both lungs. Spleen + + + +. Blood smear E.A., 0+. Tert. 0 + + + +. Received 7 daily rectal injections of quinine; 3 of 45 grs., and 4 of 60 grs. Blood smear, negative on 7th day. Temperature lowered on 6th day. No tenesmus; all injections retained. Died on 49th day. Autopsy: Acute general miliary tuberculosis; tubercular meningitis.

#### TECHNIQUE OF ADMINISTRATION

Upon admission and diagnosis, the patient is given by mouth 2 ozs. saturated solution of magnesium sulphate. Two hours later, a soapsuds enema is ordered and, an hour after expulsion of the enema, 60 grains (average adult dose) of powdered quinine sulphate in 2 ozs. of olive oil is deposited in the rectum. Doubt concerning the expulsion of the cleansing enema may be eliminated if desired by washing out the colon with water before giving quinine. The quinine mixture should be well stirred and shaken to ensure even emulsification. It is poured into a funnel connected with a large soft rubber catheter or rectal tube, which has been introduced 3-4 inches into the rectum, and allowed to enter the rectum by gravity. A rubber bulb syringe may be used. When the last of the emulsion has gone through the funnel, the catheter is gently "milked" toward the anus to ensure deposition of the entire dose. The catheter is then withdrawn, and the patient told to resist all inclination to defecation for 6 hours. If the colon has been well evacuated prior to treatment, there is seldom any difficulty in carrying out this technique. Rest in bed is, in most cases, a necessity. In seriously ill patients it may, of course, be imperative that quinine be given immediately upon admission. The preliminary dose of magnesium sulphate may then be dispensed with; the patient receiving an enema upon admission, and the quinine enema as soon as the cleansing enema is expelled.

After the first treatment is given, the following routine is established: One hour before the evening meal, the patient is given 2 ozs. of magnesium sulphate. This will normally assure a complete evacuation before the patient has gone to sleep. At 7 a.m. the following morning, a soapsuds enema is administered, and at 8 a.m. or after expulsion of the enema, the quinine-oil instillation is carried out. In this manner, sleep is not interfered with, and the patient is able to devote his energy to the necessity of retaining the deposited dose of quinine for 6 hours. During this period of the day, he is easily kept under observation. It is not necessary to restrict fluids during the 6-hour interval (although some patients find it more convenient to do so) and the dietary is not interrupted. At 2 p.m. the patient is told that he is at liberty to evacuate his bowels. Many find this unnecessary, securing sufficient elimination from the nocturnal saline aperient and morning enema. In this method of treatment, quinine is administered only once during each 24 hours.

## RESULTS AND RATIONALE OF TREATMENT

Analysis of the cases reported indicates that quinine administered in the manner described compares favorably in effectiveness with its use by more conventional methods. Although the rate of absorption and elimination has not been tested, it appears probable that quinine emulsified in olive oil is absorbed slowly through the rectal mucosa and the lymphatic tributaries of the portal system. Suggestive of this slow but regular assimilation of quinine is the fact that symptoms of cinchonism are often diminished in severity, and are sometimes absent.

No patients have been unable to carry out the treatment. A few injections have been expelled—these have been replaced quantitatively. A single patient has complained of tenesmus, and one of abdominal discomfort. No instances of diarrhoea or bloody stools have been noted.

A probable advantage in treating estivo-autumnal malaria by this method is furnished by the knowledge that estivo-autumnal parasites sporulate, to a large extent, in the portal tributaries, where they would be particularly exposed to contact with the quinine-derivatives emanating from the pararectal lymphatics and venous sinuses.

The fact that substances absorbed from the rectum (whether by venous channels or the lymphatic system) are conveyed to the liver, may constitute an added advantage in hastening the development of the active quinine derivatives or "metabolites." Quinine when orally administered rapidly finds its way in part, at least, to the systemic circulation, where its dissemination produces the symptoms of cinchonism.

From a practical standpoint, the method of treatment herein described has some merit in dealing with large numbers of ward patients. Two well-trained orderlies can carry out the treatment on a number of persons in a surprisingly short time.

Plasmochin may be added to the emulsion. By so doing, anti-malarial therapy may be reduced to a single daily dose of quinine and plasmochin. The expense of olive oil must of course be added to treatment. Ulcerative colitis, anal fissure and inflamed hemorrhoids may be contraindications to any form of rectal therapy.

## CONCLUSIONS

1. Satisfactory results in reduction of malaria temperature and elimination of parasites from the peripheral blood have been attained by the rectal administration of quinine in olive oil.

2. This method has not been employed in gastro-intestinal or cerebral cases. Selective use of the method in these and other grave forms of malaria is indicated if speed of action is not of primary concern, and if adequate control of administration is assured.

3. Certain disadvantages and objectionable features of other methods of quinine administration are foreign to its use by rectum.

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SOME RECORDS CONCERNING TRAUMATISM AND MALARIA IN  
CENTRAL AMERICA\*

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Visitors to the Isthmus of Panama during the construction period of the Panama Canal frequently sought information concerning the leading causes of death and most of them were greatly surprised to learn that yellow fever, plague, and beriberi, were not among the leading causes of illness and death. It was less difficult to control these diseases than others, but the tragic part they played in the tropics before this period is still uppermost in the minds of many visitors.

I have arranged, in Table I, the various diseases commonly inquired about by visitors. These represent the causes of death determined at autopsy at Ancon, Canal Zone, from 1904 to 1919.

For comparison with this record I have arranged Table II to show the leading causes of death in the order of their incidence.

Autopsies were performed on 70 to 90 per cent of the bodies that passed through the Board of Health Laboratory each month so that I believe these autopsy records furnish a fair index of the relative incidence of the causes of death in the Canal Zone. It is thus shown that the chief causes of death were due to pneumonia and tuberculosis. Malaria is the only disease, commonly listed as a tropical disease, that ranks among the first five causes of death in this

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series of cases, yet the combined forms of external violence exceeded the death rate of malaria. It is not surprising that the construction period of the Panama Canal should reveal many deaths due to violence. The fall in the number of

TABLE I

## CAUSES OF DEATH REVEALED BY AUTOPSY

Year	N.A.	Y.F.	B.	A.	T.	I.D.C.	P.	S.P.	S.B.	C.	F.
1904	6	..	..	..	..	..	..	..	..	..	..
1905	269	12	7	7	2	..	1	..	..	..	..
1906	509	1	5	4	..	..	..	..	..	..	..
1907	496	..	1	2	1	..	..	..	..	..	..
1908	361	..	1	2	3	..	..	..	..	..	..
1909	295	2	..	..	..	..	1	..	..	..	..
1910	451	2	..	..	..	..	..	..	..	..	..
1911	508	..	1	1	1	..	1	..	..	..	..
1912	425	1	..	..	1	4	..	..	..	..	..
1913	460	..	..	2	3	1	..	..	..	..	..
1914	375	..	1	..	4	2	..	..	..	..	..
1915	328	3	1	..	2	1	..	..	..	..	..
1916	323	..	2	..	..	3	..	1	..	..	..
1917	330	..	7	..	1	2	..	..	..	..	..
1918	253	..	..	2	..	3	..	..	..	..	..
1919	324	2	..	..	..	3	..	..	..	..	..
Totals. . . . .	5,713	23	26	20	18	19	3	1	..	..	..

N.A., Number of autopsies; Y. F., yellow fever; B., beriberi; A., ankylostomiasis; T., tetanus; I. D. C., infectious diseases of children; P., plague; S. P., small pox; S. B., snake bite; C., cholera; F., filariasis.

TABLE II

## CAUSES OF DEATH REVEALED BY AUTOPSY

Year	N.A.	P.	T.	Trau.	M. & H. F.	N.
1904	6	1	1	..	..	..
1905	269	60	9	3	27	8
1906	509	191	22	24	50	23
1907	496	156	35	40	27	27
1908	361	59	63	26	46	25
1909	295	55	37	32	26	31
1910	451	50	91	30	52	37
1911	508	83	102	38	41	36
1912	425	53	79	37	23	27
1913	460	47	89	34	21	26
1914	375	36	78	38	6	12
1915	328	28	56	20	14	12
1916	323	25	81	17	8	20
1917	330	24	51	21	5	23
1918	253	38	68	6	6	12
1919	324	22	55	15	3	14
Totals. . . . .	5,713	928	917	381	355	333

N. A., number autopsies; P., pneumonia; T., tuberculosis; Trau., traumatism; M. and H. F., malaria and hæmoglobinuria; N., nephritis-chronic fever.

deaths due to traumatism has not been as great during the period of operation and maintenance as one might think, because the automobile, the airplane, and shop machinery are taking their toll.

Mortality rates do not necessarily reflect the incidence of diseases of the greatest economic importance as can be shown in the case of malaria.

It has been my duty in recent years to conduct rather extensive surveys for malaria in the labor camps of a large agricultural organization operating along the mainland and in certain islands of the Caribbean Sea. These surveys were made on all the men, women, and children found in the labor camps at the time of my visit. A microscopic examination of a blood film from each individual was done. The method used was the thick-drop-film stained and laked in an aqueous solution of Giemsa's stain. Table III shows the results of these surveys.

The island of Haiti shows about the same rate as the mainland, while Jamaica,

TABLE III  
FIELD SURVEYS FOR MALARIA

Region	1928	1927	1926
Tela (Honduras) . . . . .	18.6	24.3	23.9
Truxillo (Honduras) . . . . .	35.0	33.5	21.0
Chiriqui (Panama) . . . . .	35.6	26.7	....
Costa Rica . . . . .	19.0	34.9	29.5
Colombia . . . . .	15.2	21.3	21.0
Guatemala . . . . .	27.6	....	40.1
Almirante (Panama) . . . . .	22.9	21.9	27.1
Preston (Cuba) . . . . .	....	24.2	34.8
Banes (Cuba) . . . . .	....	24.3	35.9

TABLE IV  
HÆMOGLOBIN ESTIMATIONS ON 5,501 PEOPLE

Individuals with hæmoglobin index of	Per cent
30 per cent. . . . .	0.23
40 per cent. . . . .	0.67
50 per cent. . . . .	2.9
60 per cent. . . . .	18.3
70 per cent. . . . .	41.3
80 per cent. . . . .	29.1
90 per cent. . . . .	7.4
100 per cent. . . . .	0.09

in its worst foci, usually showed a rate of about 15 per cent. These races of high tolerance for the disease seldom seek treatment in a dispensary or hospital yet the "labor efficiency" is lowered to an important degree. Table IV shows the hæmoglobin estimations conducted. (Tallquist scale employed.)

This shows that a large proportion of the laborers scale from 60 to 70 per cent in their hæmoglobin estimations. Their ability to do manual labor in a consecutive daily manner is pretty well reflected by these same figures. Malaria, malnutrition, and intestinal parasites all participate in producing these results, but in my opinion malaria outranks the other factors.

It is difficult to impress, even on the local medical profession, how much malaria remains untreated in the field and how many individuals there are who can carry

the infection with little or no acute symptoms. In order to get some figures on this subject, I checked the field surveys in three large coastal plain areas against the hospital cases under treatment on the days I collected blood films from the field. There were 126 labor camps in these three areas which had under treatment for malaria in the hospitals just 26 cases. My survey covered only 24 of these labor camps. There were 555 individuals found positive for the parasites of malaria in these 24 camps and 137 of them were as heavily parasitized as the 26 hospital cases on the day of their admission for treatment. The individual resistance is great in these races with a high tolerance to the disease, but malaria takes its toll to some extent in each infected individual. The course of traumatic surgery and obstetrics is frequently modified by an associated attack of malaria. The doctor must constantly keep in mind this disease as well as postoperative infection since many of our postoperative temperature rises are due to malaria. In spite of the tragic part played in our past history by epidemics of yellow fever and plague, I feel sure that malaria has been and is at present the great economic problem of the tropical coastal plains. The successful development of permanent industries in the coastal plains of our tropics must be paralleled with constant efforts in the control of malaria.

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#### THE PLACE OF PLASMOQUIN IN MALARIA CONTROL\*

EUGENE R. WHITMORE, Ph.D., M.D., Dr.P.H., F.A.C.P.

For some years, in discussing the control of infectious diseases, I have used an outline which I have called an Epidemiological Triangle. (See Chart 1.) The three sides of this triangle are: 1. The Source of Infection; 2. The Mode of Transmission; and 3. The Susceptibility of the Population. Breaking any one of the three sides collapses the triangle; the disease does not spread.

Doctor Deeks has just outlined for us the method of malaria control adopted by the Medical Department of the United Fruit Company: an attack on the first and second sides of the triangle. Other than quinine prophylaxis we know nothing about an attack on the third side of the triangle in malaria control.

Today it is my purpose to look at our methods of attack on the first side of the

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triangle; the source of infection. As man is the only source of infection in malaria, we can at once limit our discussion to the infection in man.

For the purpose of the discussion we must bear in mind that in clinical malaria the asexual cycle of the malarial parasite is repeated over and over, this repetition of the asexual cycle keeping up the clinical manifestations of malaria in the infected person. These asexual forms are not infectious for the anopheles mosquito, being digested in the intestine of the mosquito the same as any other food. But, after the asexual cycle has been going for a few days, certain of the young parasites resulting from each sporulation do not go through the asexual cycle, but are differentiated to sexual forms. These sexual forms undergo no further change in the infected person, but are infectious for certain species of

### *Epidemiological Triangle*

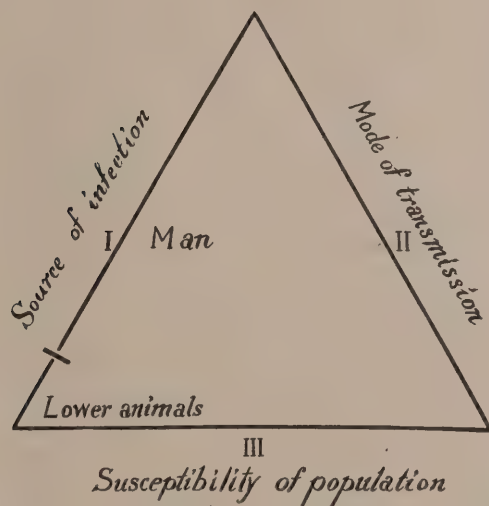


CHART I

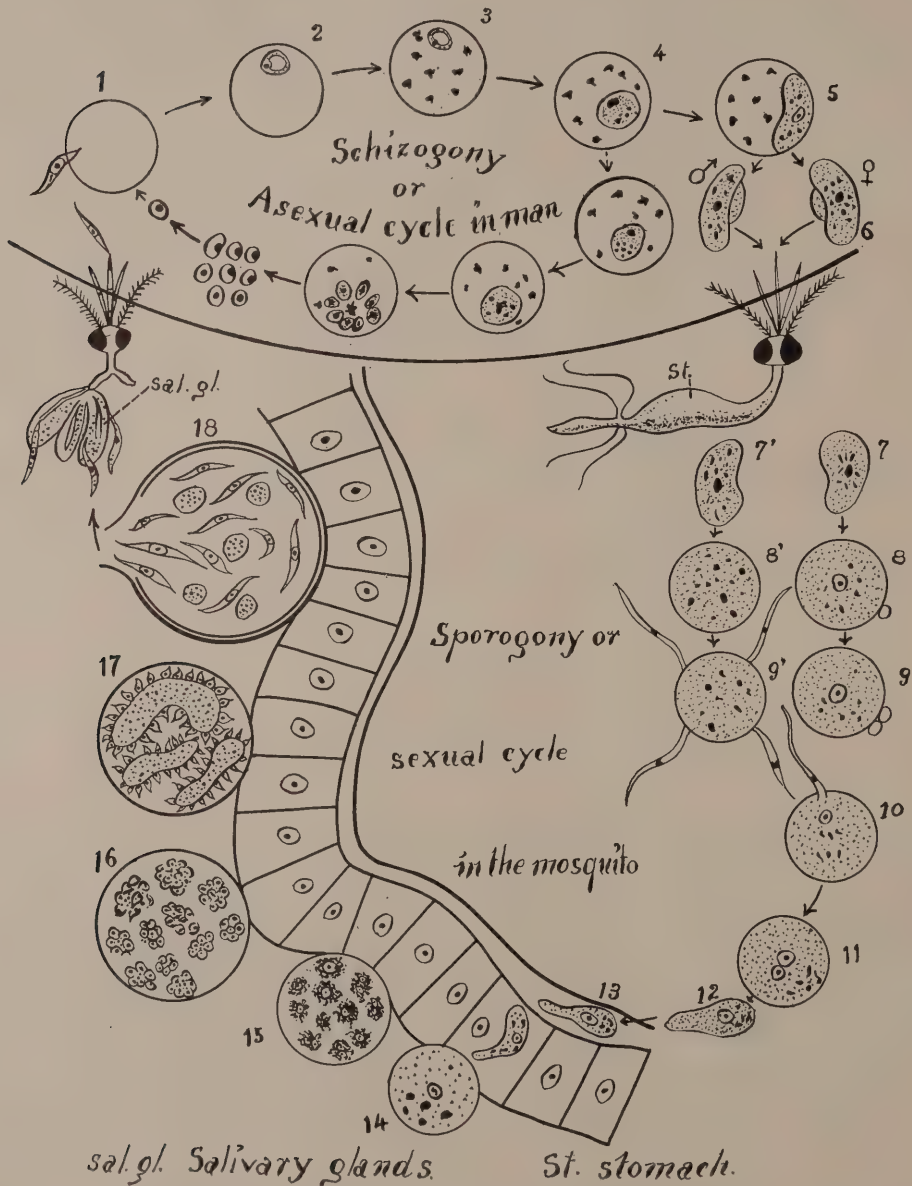
anopheles mosquitoes when drawn with blood into the midgut of such mosquitoes, and so play the part of spreading of the infection to other persons.

So, we must keep before us two forms of the malarial parasite: one that undergoes further development in man, but is not infectious for the mosquito; the other that undergoes no further development in man, but is infectious for the mosquito.

The discussion here refers entirely to the subtertian malarial parasite, and the terms gametocyte and crescent will be used interchangeably.

I thoroughly agree with Doctor Deeks that the asexual cycle is effectively controlled by the prompt administration of quinine in adequate dosage, at the onset of acute symptoms. Further, I consider that quinine is the only drug today that merits serious consideration for this purpose; and, in passing, I may say that when I find a case of malaria in a person who cannot take quinine, I consider it my problem to find some way in which that patient can take quinine.

# Cycle of development of *Plasmodium falciparum*



Modified from Brumpt

The gametocytes present a different problem. Whether or not the patient takes quinine, the crescent circulates in the patient's blood until the containing red blood cell is picked out for reworking by the reticulo-endothelial system, when the crescent is at the mercy of the phagocytes, which pick it up and digest it.

I must digress here to say again that the gametocytes undergo no further development in the body of man. This means that the gametocyte is not in any way concerned with relapse in malaria. Relapse is purely a function of the asexual cycle; the lighting up of a smouldering asexual cycle to where enough asexual parasites are in the blood to cause the symptoms of malaria. As long ago as 1918<sup>1</sup> I discussed this point at length, but the weight of Schaudinn's reputation has carried on the idea that the macrogametocyte plays a rôle in relapse. I am very glad to see that only last year Schüffner,<sup>2</sup> evidently without knowing of my discussion, found no evidence of reversion of the macrogametocyte to the schizont, and says that the theory of Schaudinn of the reversion of the macrogametocytes to schizonts cannot be considered as proved.

Let us bear this point in mind; and now we can return to the discussion of the further role of the gametocytes.

During the time the gametocytes are circulating in the blood, it is readily shown experimentally that they are infectious for certain species of anopheles, whether or not the patient takes quinine. But, while quinine has little or no action in destroying gametocytes or rendering them non-infectious for mosquitoes, plasmoquin has a marked action in this respect. The dosage used has been close to the limit of toleration by man, so that some cases of toxic action have been reported, and in a few cases death has been ascribed to the use of the drug.

Doctor Deeks considered it advisable to study the dosage of plasmoquin necessary to render the gametocytes in a case non-infectious for mosquitoes; and Barber and Komp<sup>3</sup> have reported their studies on this subject. In order to obtain further information on the subject, Doctor Deeks asked us<sup>4</sup> to repeat the work.

Working with adults and children over 17 years of age, with the patient in the hospital under quinine treatment until the asexual cycle was controlled, after a single dose of 20 milligrams (not less than 0.300 mgm. per kilo of body weight) of plasmoquin, we never saw an oocyst develop in the stomach of *Anopheles albimanus* fed for 4 to 7 consecutive days on the patient. We also found that a single dose of 10 milligrams (not more than 0.200 mgm. per kilo of body weight) of plasmoquin, was not sufficient to prevent the development of oocysts in the stomach of *Anopheles albimanus* fed 3 to 6 consecutive days on the patient. (Unfortunately our cases in which the single dose of plasmoquin was calculated so as to be 0.250 mgm. per kilo of body weight did not infect mosquitoes either before or after plasmoquin.)

Since plasmoquin is active against only the gametocytes, it is of interest to



inquire what percentage of cases of subtertian malaria develop gametocytes in the blood. In order to gather some information on this point in the Truxillo Railroad Company division in Honduras, it was arranged to reexamine the blood of all cases of malaria after they had been in the hospital on quinine treatment for three days; this in addition to the regular examination of the blood on admission and before discharge from the hospital. This system of reexamining the blood three days after the patient entered the hospital was in operation only two months while I was there, and the following table gives the figures for these two months.

TABLE I

SUBTERTIAN MALARIA. PATIENTS DISCHARGED FROM HOSPITAL DURING JULY AND AUGUST, 1929

Total discharged during July and August . . . . .	268
With crescents in blood on admission . . . . .	27
Without crescents in blood on admission . . . . .	241
Percentage with crescents in blood on admission . . . . .	10
Reexamined while in hospital:	
Without crescents in blood on admission . . . . .	186
Developed crescents in blood while in hospital . . . . .	47
Did not develop crescents in blood while in hospital . . . . .	139
Percentage developing crescents in blood while in hospital . . . . .	25.3

Another question is regarding the frequency of relapse, and the development of crescents in the blood, after the patient leaves the hospital; and I undertook to obtain some information on this point in the United Fruit Company division at Banes, Cuba, in the summer of 1928. The plan was to reexamine the blood of malaria cases at approximately weekly intervals after their discharge from the hospital, for as long a time as they could be followed. Table II gives the results of this study in the few cases that could be followed long enough to make it worth while to include them in the tabulation.

TABLE II

RELAPSE AND DEVELOPMENT OF CRESCENTS IN CASES OF SUBTERTIAN MALARIA AFTER LEAVING THE HOSPITAL

25 cases observed for 5 to 10 weeks.
7 developed crescents while in hospital.
2 of these (children) continued to have crescents in the blood throughout the period of observation.
5 relapsed after leaving the hospital (2 with some intercurrent disease).
3 of these relapsed cases developed crescents.

## DISCUSSION

The rôle of gametocytes is the infection of anopheles mosquitoes when drawn with blood into the stomach of the mosquitoes; and it is interesting to look at

this infectiousness for mosquitoes. In our work this summer, of eleven patients with numerous crescents in their blood, and in the hospital under treatment with quinine, eight were infectious for *Anopheles albimanus*, while three failed to infect this species. Barber and Komp report the same variability in infectiousness. Perhaps this variation in infectiousness has much to do with the conflicting reports on whether quinine renders gametocytes non-infectious for mosquitoes.

From our study, it appears that a single dose of plasmoquin of 0.300 mgm. per kilo of body weight is sufficient to render non-infectious for *Anopheles albimanus* all crescents in the blood at the time the single dose is taken. This is a very small dose of a drug to have such a marked action, and it is interesting to consider how the action is brought about. Is it possible that so low a concentration of this drug will destroy crescents, when they are resistant to much higher concentrations of quinine? It will be remembered that the patients had been in the hospital and on quinine treatment long enough to control the asexual stage—usually three days. It may be that the plasmoquin acts as an adjuvant to the quinine in rendering the crescents non-infectious; perhaps altering the permeability of the red cell covering of the crescent or the outer layer of the crescent itself. Many of the men who are using plasmoquin are of the opinion that it aids quinine in destroying the asexual forms; and there is some claim that quinine makes plasmoquin less toxic for the patient.

How long the concentration of plasmoquin remains high enough to render crescents non-infectious requires further work, which is under way, especially on the rate of elimination and destruction of plasmoquin in the body. From the literature we find that about 10 per cent. of the plasmoquin is eliminated from the body every 24 hours.<sup>5</sup>

Since, as already stressed, the gametocytes have nothing to do with relapse, plasmoquin has nothing to do with the prevention of relapse; and any study of the relapse rate after plasmoquin gives no information as to the action of plasmoquin on gametocytes: such information bears on the efficiency of the follow-up treatment with quinine.

The figures in the literature, regarding the percentage of cases of subtertian malaria that develop gametocytes, vary markedly. Ross and Thomson say that not over 74 per cent. of the cases develop crescents. Apparently season has something to do with the percentage developing crescents: Fülleborn saw only 5 per cent. of cases develop crescents in the beginning of the summer epidemic; 60 per cent. in November. Ziemann confirmed this in Syria. Schüffner considered that the appearance of crescents depends on previous quinization; but Ziemann was not able to confirm this.

From Table I it appears that during the two summer months of July and August, about one third of the cases of subtertian malaria in the Truxillo Railroad Company division in Honduras develop crescents in their peripheral blood, either before entering the hospital, or while in the hospital and under quinine treatment. The system of reexamination is being continued, and will be checked

up for a year or longer, and the results will be reported at a later date. With a sufficient number of cases, it will be interesting to know whether season, race, or age play any part in determining the frequency with which crescents are developed in the peripheral blood in this region.

Barber and Komp point out that a single survey gives only about one half the actual percentage of infections. It may safely be assumed that a much higher percentage of patients develop crescents than is found on two or three examinations of the blood while in the hospital. So, when we find crescents in the blood of a third or more of the patients, we may for practical purposes consider that two thirds to nearly all of the patients have crescents in the blood; and the treatment with plasmoquin would be carried out on that basis. Whether most of these patients have enough crescents in their blood to infect mosquitoes may well be a question.

In considering the results as set down in Table II, it is at once realized that the length of stay in the hospital, and the follow-up treatment with quinine play a large part in the relapse rate and the percentage who develop crescents in their blood after leaving the hospital. The number of cases collected is small; but it is difficult to follow cases for long, so we must accumulate such information from small groups of cases.

#### COMMENT

Quinine is the one outstanding drug for controlling the asexual cycle of the malarial parasite; that is, for controlling clinical malaria, preventing relapse, and stopping the formation of gametocytes.

The place of plasmoquin is in rendering gametocytes already in the blood non-infectious for mosquitoes. The two drugs are complementary, and one does not replace the other.

From the findings of Barber and Komp, and our own findings, it appears that a single dose of plasmoquin of 0.300 mgm. per kilo of body weight is sufficient to render non-infectious for *Anopheles albimanus* all crescents in the blood at the time the single dose is taken. Our findings show that a dose of 0.200 mgm. per kilo of body weight is not sufficient to render the crescents non-infectious for *Anopheles albimanus*.

Since a high percentage of cases develop gametocytes, it seems advisable to give plasmoquin to all cases of malaria after quinine has controlled the asexual stage. At present it appears that a single dose of plasmoquin amounting to 0.300 mgm. per kilo of body weight (pending further study to determine whether any smaller dose is efficient) is sufficient to render non-infectious all gametocytes in the blood at that time. This is a dose that is readily borne. There is no need for a follow-up course of plasmoquin, provided the follow-up treatment with quinine is sufficient to control the asexual cycle and so prevent relapse and the formation of further gametocytes.



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## THE ACTION OF PLASMOQUIN IN RENDERING SUBTERTIAN GAMETOCYTES NON-INFECTIOUS FOR MOSQUITOES

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In the Sixteenth Annual Report of the Medical Department of the United Fruit Company, Barber, Komp and Newman report the results of their study of the effect of small doses of plasmoquin on the viability of the gametocytes of the subtertian malaria parasite as measured by mosquito infection experiments. As this point is of great practical importance, Doctor Deeks asked us to make a further study along the lines of the work of Barber and his associates.

As one of us (W.) was engaged in a study of blackwater fever, it was desirable to carry on the study in a region where it could be expected that material for both problems would be available. This meant a supply of cases of malaria, a reasonably accessible supply of anopheles mosquitoes, and the probability of encountering cases of blackwater fever, all in a region where suitable hospital, laboratory, and transportation facilities were available. After due consideration, it was decided to carry out the study at Puerto Castilla, Honduras.

It was anticipated that the supply of mosquitoes would come from pupae and full grown larvae collected from the breeding places and hatched out in the laboratory. But the "pernicious activity" of the sanitary squad made it practically impossible to find any breeding places that would supply sufficient pupae and larvae within a reasonable distance of the hospital. As soon as we went

farther out into the country for the pupae and larvae, we found that the jar of the motor car (running on the rails of the railroad) caused most of the larvae and pupae to be drowned by the time we reached the laboratory. This, with the high percentage of males hatching out from the collected larvae and pupae, and the high mortality among the young females before they could be induced to bite, made it evident that we would have great difficulty in securing sufficient mosquitoes for our work by this method; and it seemed that we would have to build an inclosure and put up nets and protection over a natural breeding place, in order to obtain a supply of mosquitoes.

At this juncture we turned to the anopheles which collected on the hospital screens every morning, evidently coming from breeding places in the extensive and almost impassable swamp a short distance beyond the canal back of the laboratory. In this way we obtained an ample supply of female anopheles, ready fertilized, vigorous—as only the vigorous would make the flight—and ready to bite. Over one thousand anopheles were collected from the hospital screens from June 27 to September 1; and in this number were five male *Albimanus*, and seven female *Crucians*; all of the others were female *Albimanus*. During July and to the middle of August the anopheles were abundant, and we could have caught many more, had we had the facilities or the need for them. With the coming of the hot dry weather, from about the middle of August, very few anopheles were collected from the hospital screens.

With our supply of anopheles assured, it was necessary to consider whether they were already infected, as some families live in the edges of the swamp, and part of the laborers of the town are quartered beyond the canal and toward the swamp. Aside from the large numbers collected daily, we had the knowledge that female anopheles are very much inclined to remain in a house in which they find food, only leaving to go to water to deposit their eggs. Our large supply of anopheles made it possible for us to dissect large numbers of them, to determine whether any or many of them were infected when caught. In order further to guard against infection before they were caught interfering with our results, all anopheles were fed on guinea pigs for at least seven days before being used in the experimental feedings. The idea here was that any oocysts in the stomachs of the mosquitoes when caught would develop during this time to where they would not be confused with younger oocysts of known age from our experimental feedings. In the entire study there was a single body in the stomach of each of four mosquitoes that we interpreted as oocysts in an advanced stage of segmentation. In all other cases the oocysts were at the stage of development we would expect in our experimental feedings. The salivary glands were always examined, and in no instance were sporozoites found.

Our general rule was to give the patient 30 grains of quinine daily, for the first three days, then to reduce the quinine to 15 grains daily, for the next four days, and then to reduce the quinine to 10 grains daily as long as the patient was in the hospital (only a few days). For reasons of convenience, the daily amount of

quinine was given in two doses. Two comatose cases received quinine intramuscularly until able to take it by mouth.

A batch of "before plasmoquin" mosquitoes was fed on the patient during the first 24 hours in the hospital; the same batch being ordinarily allowed to feed on each of the next two days. As mosquitoes seldom feed in 24 hours after a full meal, this meant that all of these mosquitoes ordinarily fed twice on the patient.

The patient was then given a single dose of plasmoquin, and a batch of "after plasmoquin" mosquitoes was fed daily on the patient as long as the patient was under observation (always until we had a report from the hospital laboratory that the patient's blood was negative for crescents)—from five to seven days. This meant that each mosquito in this batch ordinarily fed three times; and by the end of the feedings no crescents were found in the blood of the patient. In three cases, two batches of "after plasmoquin" mosquitoes were fed on the patient—these and other deviations from our general plan of study are brought out in the tabulations. Our reason for feeding the same mosquitoes repeatedly on the same case, rather than to use a different batch for each feeding, was to overcome the difficulty that mosquitoes frequently do not become infected at a single feeding, while the chance of infection is greatly increased by feeding them two or three times.

After completion of the feedings on patients, the mosquitoes were fed on guinea pigs until such time as any oocysts present would be developed to where they would be readily recognized under the dry objectives of the microscope.

Thick drops of blood were prepared daily from each patient during the feedings, and the number of rings and crescents was indicated by the usual convention of one or more "plus" signs. These slides were carried back to Washington, where the crescents per 1000 leucocytes were recorded, as was done by Barber and his associates. To add further to our knowledge of the number of crescents in the smears, the number of crescents found in a five minute search with the  $\frac{1}{12}$  inch objective and mechanical stage (as previously used by one of us (W.) and others in malaria studies) was recorded; and the results of the three determinations are entered together in the tabulations.

When we were ready to begin our study there were two cases in the hospital who had been receiving a daily dose of 10 mgm. of plasmoquin for five days, and we fed mosquitoes on them. As there were no "before plasmoquin" mosquitoes in these two cases, and they were not limited to a single dose of plasmoquin, we have not included them in the regular series, and have designated them as Case A and Case B.

*Anopheles albimanus* was used for all feeding experiments; and the results of the study are tabulated for each case, as follows.



CASE No. A

Name: D. B.  
Nationality: Jamaica.  
Age: 24 years.

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leu- cocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
1	20 mgm. daily	30 grains daily	quinine in divided doses plasmoquin at 5:00 p.m.		++	50 (48)				
2					—	—				
3					0	198				
4		15 grains daily			—	—				
5					—	—				
6				4:45 p.m.	0	33				
7				4:00 p.m.	0	12 (7)				
8				4:00 p.m.	0	—	10	0	0	—

See table of Case No. 1 for explanation of "plus" signs in "Subtertian Rings" column, and of figures in parenthesis in "Gametocytes per 1000 Leucocytes" column.

CASE No. B

Name: J. H.  
Nationality: Jamaica.  
Age: 55 years.

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
1	20 mgm. daily	30 grains daily	quinine in divided doses plasmoquin at 5:00 p.m.		++	22				
2					—	—				
3		15 grains daily			0	186				
4					—	—				
5					—	—				
6				10:00 a.m.	0	0				
7				4:00 p.m.	0	0				
8				4:00 p.m.	0	0	7	0	0	—

## CASE No. 1

Name: E. W.

Nationality: British Honduras.

Age: 17 years.

Weight: 50.5 kilos (111 lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm.		20 grains daily	divided doses	3:00 p.m.	+	103 (47)				
1		30 grains daily	divided doses	4:15 p.m.	—	++ 3				
2				3:00 p.m.	—	—				
3				3:00 p.m.	—	—				
4	10 mgm. once		8:00 p.m.	3:00 p.m.	0	98	4	4	100	fair num- ber
5		15 grains daily	divided doses	2:30 p.m. 19 hours after plasmo- quin	0	89				
6				3:00 p.m.	0	12				
7				2:40 p.m.	0	12 (34)				
8				2:30 p.m.	0	25 (30)				
9				2:30 p.m.	0	8 (22)				
10				2:30 p.m.	0	1 (12)				
11				2:30 p.m.	0	1 (22)				
12				2:30 p.m.	0	0 (8)	14	7	50	1 to 10

Plasmoquin dosage is 0.198 mgm. per kilo of body weight.

Figures in parenthesis, in "Gametocytes per 1000 Leucocytes" column, are number of crescents found in 5 minutes search of the same slide, with a  $\frac{1}{12}$  inch objective.

In the "Subtertian Rings" column, ++ means, numerous; + means, present in fair number; (+) means, scarce.

In the "Gametocytes per 1000 Leucocytes" column, the "plus" sign below the figures in parenthesis, represent the opinion of the examiner on the number of crescents present, at the time the blood was examined in the field; and the "plus" signs here have the same meaning as in the "Subtertian Rings" column.



CASE No. 2

Name: F. V.

Nationality: Honduras.

Age: 21 years.

Weight: 56 kilos (123 $\frac{1}{4}$  lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm.		30 grains daily	in two doses		++	183 (35)				
1	10 mgm. once		5:00 p.m.	3:15 p.m.	+	78 (84)	10	10	100	1 to 30
2				3:30 p.m.	(+)	16 (42)				
				23 $\frac{1}{2}$ hrs. after p'moquin		+				
3		15 grains daily		2:30 p.m.	0	16 (34)				
4				4:45 p.m.	0	0 (37)				
5				4:00 p.m.	0	9 (3)				
6				4:00 p.m.	0	0 (2)				
7				4:00 p.m.	0	0 (2)	10	1	10	4

Plasmoquin dosage is 0.179 mgm. per kilo of body weight.

CASE No. 3

Name: A. C.  
Nationality: Honduras.  
Age: 17 years.  
Weight: 48.6 kilos (107 lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leu- cocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm. 1	10 mgm. once	30 grains daily	in two doses 5:00 p.m.	3:15 p.m.	++ ++	(66) ++ 135 (61) ++	7	3	43	1 each
2				3:30 p.m. 23½ hrs. after p'moquin	0	3 (45) +				
3		15 grains daily	in divided doses	2:30 p.m.	0	251 (82) +				
4				4:45 p.m.	0	5 (44) +				
5				4:00 p.m.	0	0 (+)				
6				4:00 p.m.	0	0 (15) (+)				
7				4:00 p.m.	0	0 (+)*	10	1	10	1

Plasmoquin dosage is 0.206 mgm. per kilo of body weight.  
\* Note is "crescents badly deformed and broken."

CASE No. 4

Name: A. D.

Nationality: Nicaragua.

Age: 33 years.

Weight: 58.6 kilos (129 lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm.		30 grains daily	in two doses		+	+				
1				10:30 a.m.	+	18				
2				3:00 p.m.	0	11				
3	20 mgm. once		5:00 p.m.	3:00 p.m.	0	4				
							12	12	100	3 to many
4		15 grains daily	in two doses	1:00 p.m. 20 hrs. after p'moquin	0	0 (38) +				
5				2:30 p.m.	0	0 (20) +				
6				3:30 p.m.	0	1 (+)				
7				3:00 p.m.	0	2 (+)				
8		10 grains daily	in two doses	12:30 p.m.	0	3 (+)				
9				2:00 p.m.	0	0				
10				2:00 p.m.	0	0	15	0	0	—

Plasmoquin dosage is 0.341 mgm. per kilo of body weight.



## CASE No. 5

Name: C. D.

Nationality: Jamaica.

Age: 38 years.

Weight: 61.4 kilos (135 lbs.).

Diagnosis: Subtertian Malaria.\*

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Leucocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
1		30 grains mouth & intra-musc.	divided doses	3:00 p.m.	++++	191 (210) +++				
2		60 grains mouth & intra-musc.	divided doses	3:00 p.m.	+	6 ++				
3		30 grains intra-musc.	in two doses	4:00 p.m.	++	241 ++	10	3	30	5 to many
4	20 mgm. once	30 grains mouth & intra-musc.	8:00 a.m.	7:00 p.m. 11 hrs. after pqn. in two doses	(+)	223 (242) ++				
5		30 grains daily	in two doses	1:30 p.m. 29½ hrs. after pqn.	0	192 (116) ++				
6		15 grains daily	in two doses	2:30 p.m.	0	5 ++				
7				2:30 p.m.	0	0 +				
8				2:30 p.m.	0	0				
9				2:30 p.m.	0	0				
10				2:30 p.m.	0	(+) 0 0	20	0	0	—

Plasmoquin dosage is 0.326 mgm. per kilo of body weight.

\* Patient comatose.

CASE No. 6

Name: B. S.

Nationality: Honduras.

Age: 23 years.

Weight: 60 kilos (132½ lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
1		30 grains daily	divided doses	4:00 p.m.	0	5 (35) ++				
2				2:30 p.m.	0	3 (40) +				
3	20 mgm. once		5:00 p.m.	3:30 p.m.	0	88 +	11	0	0	—
4		15 grains daily	divided doses	3:00 p.m. 22 hrs. after pqn.	0	36 (82) +				
5				12:30 p.m.	0	6 (53) +				
6				2:00 p.m.	0	0 (40) +				
7				2:00 p.m.	0	0 (+)				
8				2:00 p.m.	0	0 0	11	0	0	—

Plasmoquin dosage is 0.333 mgm. per kilo of body weight.

## CASE No. 7

Name: L. Y.

Nationality: Spain.

Age: 50 years.

Weight: 58.6 kilos (131 lbs.).

Diagnosis: Subtertian Malaria.\*

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
1		22½ grains intra-musc.	on adm.		++	++				
		22½ grains intra-musc.	6 hours later							
2		30 grains intra-musc.	in two doses	4:00 p.m.	+	102 ++				
3		30 grains daily	in two doses	4:00 p.m.	(+)	98 (40)				
4	20 mgm. once		5:00 p.m.	1:45 p.m.	0	0† +	11	2	18	1 and 2
5		15 grains daily	in two doses	3:00 p.m. 22 hrs. after pqn.	0	0 +				
6				3:00 p.m.	0	0 +				
7				3:00 p.m.	0	0 0				
8				3:00 p.m.	0	0 (+)				
9				3:00 p.m.	0	0 0	11	0	0	—

Plasmoquin dosage is 0.341 mgm. per kilo of body weight.

\* Patient comatose.

† A few of the smears were not well stained. The crescent counts were not made in the field (only the "plus" estimate of the number of crescents was made in the field); the slides being carried back to Washington, and the counts made there. Some of the slides had faded, and others had gone to pieces rather badly; so it was difficult to make the counts in some slides. Evidently it is advisable to make the counts in the field at the time the work is being done.



CASE No. 8

Name: F. L.  
Nationality: Honduras.  
Age: 18 years.  
Weight: 48.6 kilos (107 lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm.		30 grains daily	in two doses		++	+				
1				3:45 p.m.	++	176 (55)				
2				3:00 p.m.	+	89 (45)				
3	5 mgm.* once		5:00 p.m.	3:00 p.m.	0	50	9	9	100	4 to many
4	15 mgm. once		5:00 p.m.	8:00 a.m. 15 hrs. after pqn.*	0	0	2*	2	100	9 and 11
5		15 grains daily	in two doses	3:00 p.m. 22 hrs. after pqn.	0	15 (45)				
6				3:00 p.m.	0	0 (42)				
7				3:00 p.m.	0	0				
8				3:00 p.m.	0	0 (11)				
9				3:00 p.m.	0	0	8	0	0	—

\* The plasmoquin dose was calculated to 0.300 (0.309) mgm. per kilo; but, through misunderstanding, only 5 mgm. (0.103 mgm. per kilo) was given. The 15 mgm. dose (0.309 mgm. per kilo) was given 24 hours later. Only two mosquitoes had fed at the time the error was detected, and the feeding was discontinued; a new batch of mosquitoes was used for the next feedings.

## CASE No. 9

Name: C. F.

Nationality: Honduras.

Age: 17 years.

Weight: 49.3 kilos (108½ lbs.).

Diagnosis: Subtertian Malaria

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leu- cocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm.		30 grains daily	in two doses		++	++				
1				3:45 p.m.	+	283 (155)				
2				3:00 p.m.	(+)	++ 193 (120)				
3	5 mgm.* once		5:00 p.m.	3:00 p.m.	0	++ 89 ++	10	10	100	1 to many
4	15 mgm. once		5:00 p.m.	8:00 a.m. 15 hrs.* after pqn.	0	63 ++	2*	2	100	6 and 10
5		15 grains daily	in two doses	3:00 p.m. 22 hrs. after pqn.	0	41 (190) ++				
6				3:00 p.m.	0	++ 15 (200)				
7				3:00 p.m.	0	++ 0				
8				3:00 p.m.	0	+ 0 (30)				
9				3:00 p.m.	0	+ 0 +	11	0	0	—

\* The plasmoquin dose was calculated to 0.300 (0.304) mgm. per kilo; but, through misunderstanding, only 5 mgm. (0.101 mgm. per kilo) was given. The 15 mgm. dose (0.304 mgm. per kilo) was given 24 hours later. Only two mosquitoes had fed at the time the error was detected; a new batch of mosquitoes was used for the later feedings.

CASE No. 10

Name: G. H.

Nationality: Jamaica.

Age: 24 years.

Weight: 66 kilos (145 $\frac{1}{4}$  lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm.		30 grains daily	in two doses		+	+				
1					—	—				
2					—	—				
3					—	—				
4				4:00 p.m.	0	193 (315) ++				
5				4:00 p.m.	0	302 (270) ++				
6	16.5 mgm. once		4:10 p.m.	4:00 p.m.	0	289 (240) ++	6	0	0	—
7				2:15 p.m. 22 hrs. after pqn.	0	183 (245) ++				
8				3:00 p.m.	0	0 (150) +				
9		15 grains daily	in two doses	3:00 p.m.	0	0 (15) ++*				
10				3:00 p.m.	0	0 (25) +				
11				3:00 p.m.	0	0				
12				3:00 p.m.	0	0				
13				3:00 p.m.	0	0				
14				3:00 p.m.	0	0	7	0	0	—

Plasmoquin dosage is 0.250 mgm. per kilo of body weight.

\* The field note is "still many crescents; do not stain well, often appearing as a clump of pigment."



CASE No. 11

Name: A. M.  
Nationality: Honduras.  
Age: 18 years.  
Weight: 49.6 kilos (109 lbs.).

Diagnosis: Subtertian Malaria.

Day	Treatment			Hour Mosquitoes Fed	Subtertian Rings	Gametocytes per 1000 Leucocytes	Results of Mosquito Dissection			
	Plasmoquin	Quinine Sulphate	When Given				Number Dissected	Number Positive	Per Cent Mosquitoes Positive	Number of Oocysts per Positive Gut
on adm.		30 grains daily	in two doses		++	209 (65)				
1				4:20 p.m.	+++	301				
2				4:00 p.m.	+	193 (5)				
3	12.4 mgm. once		5:00 p.m.	4:00 p.m.	+	0	2	0	0	—
4				4:00 p.m. 23 hrs. after pqn.	0	108 (40)				
5				4:00 p.m.	0	8 (30)				
6				4:00 p.m.	0	87				
7				4:00 p.m.	0	0	8	0	0	—

Plasmoquin dosage is 0.250 mgm. per kilo of body weight.

DISCUSSION

We have no intention of drawing any conclusions from the study; but a general analysis of the results brings out some interesting points. Cases A and B did not infect mosquitoes; but, as there were no "before plasmoquin" mosquitoes, these two cases are left out of consideration.

Of the eleven cases on which mosquitoes were fed before the patient took plasmoquin, eight infected mosquitoes, and three failed to infect mosquitoes. Of the eight that infected mosquitoes, five infected 100 per cent. of the mosquitoes, one infected 43 per cent., one 30 per cent., and one 18 per cent. In addition to this variation in the percentage of mosquitoes becoming infected, the tabulations show the marked variation in the number of oocysts in the stomachs, even within any single batch of mosquitoes

Of the three cases that failed to infect mosquitoes before the patient took plasmoquin, Case No. 6 was studied during the good weather; and, while the case did not show as many crescents as did some of the other cases, it showed more crescents than did some of the cases that infected 100 per cent. of mosquitoes. Cases Nos. 10 and 11 were studied late in the summer, when the weather was hot and dry; but both of these cases showed abundant crescents. In Case No. 11, probably too few mosquitoes lived through the feedings to allow one to say that this case was not infectious for mosquitoes. As far as could be determined, none of these patients had received plasmoquin before coming into the hospital, and none received plasmoquin other than that prescribed for them in the course of the study. Possibly this failure of 27.3 per cent. of the cases to infect mosquitoes explains some of the discrepancies in reports as to whether or not quinine renders subtertian gametocytes non-infectious for mosquitoes.

Turning to the "after plasmoquin" mosquitoes, we find that, in three cases, a single plasmoquin dose of up to 0.206 mgm. per kilo of body weight did not prevent infection of mosquitoes; though, in each case, the percentage infected was lower than in the corresponding "before plasmoquin" mosquitoes. In another three cases, a single plasmoquin dose of 0.326 to 0.341 mgm. per kilo of body weight prevented infection of mosquitoes fed 20 hours to several days after that single dose of plasmoquin. One case (No. 6) on this dose failed to infect "before plasmoquin" mosquitoes, so does not come into consideration here.

A misunderstanding brought an uncertainty into the results in two cases in which the single plasmoquin dose was calculated to be 0.304 to 0.309 mgm. per kilo of body weight. In each case the dose would have been 15 mgm. of plasmoquin, but only 5 mgm. was given. The 15 mgm. dose was given 24 hours after the 5 mgm. dose, and neither of the cases infected mosquitoes after the 15 mgm. dose. The question of how much of the 5 mgm. dose had been destroyed in the body or excreted makes it impossible for us to say whether or not the single dose of 0.304 to 0.309 mgm. per kilo was all the plasmoquin present in the body in an active state following the 15 mgm. dose.

Unfortunately the two cases (Nos. 10 and 11) in which the single plasmoquin dose was calculated to 0.250 mgm. per kilo of body weight failed to infect "before plasmoquin" mosquitoes, so we have no results to report for that dosage.

#### REMARKS

It appears that, under proper conditions and control, captured mosquitoes can serve for experimental feeding studies when it is not practicable to breed out the mosquitoes from a natural breeding place or from collected larvae and pupae.

From our cases it appears that a single plasmoquin dose of about 0.325 mgm. per kilo of body weight will render the crescents in the body at that time non-infectious for mosquitoes; and that a single dose of 0.206 mgm. per kilo of body weight is not sufficient for this purpose. Our results from a single dose of 0.304

to 0.309 mgm. per kilo of body weight are complicated by our lack of knowledge as to how much of a single dose of 0.101 to 0.103 mgm. per kilo, 24 hours before, was still present in an efficient state in the body. Both patients given a single dose of 0.250 mgm. per kilo of body weight failed to infect "before plasmoquin" mosquitoes, so we have no results to report for that dose.

The work is being continued.

## PLASMOCHIN IN THE TREATMENT OF MALARIA

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With the object of developing some definite data concerning the comparative value of quinine and plasmochin, respectively, in the treatment of malaria, a series of three hundred cases of malaria was studied. In each instance, a thick-film was examined on admission and another after four days of treatment. Each patient in one group of a hundred cases was given 30 grs. of quinine daily; the patients in the second group of a hundred cases received a daily dose of plasmochin-compound, containing 0.045 gm. of plasmochin and 0.54 gm. of quinine sulphate; and those in the third group were given plasmochin alone, the daily amount being 0.06 gm. The percentages of the different varieties of malaria parasites found in the blood of the patients included in these three different groups were fairly equal. Seventy-five per cent of all the cases studied were of the aestivo-autumnal type.

TABLE 1

PERCENTAGES OF DIFFERENT VARIETIES OF MALARIAL PARASITES FOUND ON FIRST EXAMINATION OF BLOOD

	Cases Treated with Quinine	Cases Treated with Plasmochin- Compound	Cases Treated with Plasmochin Only
Aestivo-autumnal . . . . .	79	79	78
Aestivo-autumnal and tertian . . . . .	4	4	0
Tertian . . . . .	14	11	17
Quartan . . . . .	3	6	5
Total . . . . .	100	100	100

TABLE 2

RESULTS AS SHOWN BY BLOOD EXAMINATIONS AFTER FOUR DAYS OF TREATMENT

	Quinine Treat- ment 30 grs. Daily For 4 Days	Plasmochin Com- pound Treatment— 0.045 gm., Plasmochin and 0.54 gm., Quinine Daily For 4 Days	Plasmochin Treatment—0.06 gm., Plasmochin Daily For 4 Days
Crescents . . . . .	30	18	6
Parasites of all kinds, including crescents. . . . .	47	38	45



## SUMMARY

The greatest contrast in the results obtained, after 4 days of treatment, was between the group treated with quinine and the group treated with plasmochin alone.

In the group treated with quinine only, 30 cases showed crescents still present after 4 days of treatment.

In the group treated with plasmochin only, 6 cases showed crescents still present after 4 days of treatment.

Although the percentage of persons whose blood showed asexual forms of parasites present after 4 days of treatment was approximately the same in the group treated with plasmochin as in the group treated with quinine (45 per cent in the former and 47 per cent in the latter), the plasmochin-treated group showed almost twice as many asexual forms of parasites per microscopic field as the quinine-treated cases.

The tertian parasite disappeared oftenest under each of the three methods of treatment, and seemed to be the type most readily affected by treatment.

The quartan parasite showed the highest resistance to treatment.

In the group treated with plasmochin alone, epigastric pain occurred eighteen times and cyanosis three times, although mild stages of the latter may have been overlooked.

One case of haemoglobinuria developed during the fourth day of treatment with plasmochin alone.

## CONCLUSION

Plasmochin is easy to take, and is well-tolerated by the stomach; but its usage is limited by the fact that distressing epigastric pains develop frequently when it is given in larger doses, and the optimum dose would seem to be not more than 0.045 gm. The effect which plasmochin has on the gametes makes it a valuable drug in the treatment and eradication of malaria; and it is the opinion of the author that it destroys the asexual forms also, but is far inferior to quinine in this respect.

The personal experiences of the writer would indicate that 0.04 gm. of plasmochin and 20 grs. of quinine sulphate daily, is an effective and well-tolerated method for treating malaria.

## THE INFLUENCE OF PLASMOCHIN ALONE ON THE SCHIZONTS OF ESTIVO-AUTUMNAL MALARIA

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Since the introduction of plasmochin for the treatment of human malaria (Archiv fuer Schiffs- und Tropenhyg., Band 30 Beifheft No. 3, 1926), the positive therapeutic action of the drug on the sexual forms of estivo-autumnal malaria has been sufficiently proved. In his original report (idem) Muehlens advised the combination of plasmochin and quinine (plasmochin comp.) as he had demonstrated that in patients under treatment with plasmochin alone, there was a persistence or reappearance of the asexual forms of estivo-autumnal malaria in at least 59% of the cases; whereas "the parasitological and clinical effect with this drug upon quartan and tertian malaria was excellent." This selective action of plasmochin on quartan and tertian parasites is certainly a striking feature.

In order to determine the effect, if any, on the ring forms of estivo-autumnal parasites, I undertook a study of their changes in the peripheral blood during the first 28 hours of treatment with plasmochin alone. I did not think it advisable to extend the observations over a longer period; as we have frequently seen the symptoms of malaria infection subside spontaneously and the peripheral blood examinations reveal a marked diminution or a disappearance of the parasites, within 2 or 3 days without any antimalarial treatment.

*Treatment with Plasmochin Alone.*—Intramuscular injections of pure plasmochin were given over a period of 24 hours to 20 patients. Each patient received four 0.03-gram doses, administered 4 or 8 hours apart as shown below. From each case, 6 thick-film-blood smears were taken and examined; the first immediately preceding the first dose of plasmochin, and the last 4 hours after the final dose.

The number of parasites were estimated in ratio to the leucocytes. At least 1,000 white cells were counted in each thick film, and the ratio reduced to 200 leucocytes. In order to avoid a relative inaccuracy in our figures, through a variation of the absolute number of leucocytes during the time of observation, an estimation of the absolute number of leucocytes was made at the beginning and the end of 28 hours. For this purpose a thin film was examined according to the method advised by Schilling (Das Blutbild, 1929). Cases which showed marked difference between the first and second leucocyte estimation were excluded from the series.

The treatment and examination of the cases were carried out according to the following scheme:

x—1st thick film taken, followed immediately by 1st injection of 0.03 grams of plasmochin

4 hours later—2nd thick film taken, followed immediately by 2nd injection of 0.03 grams of plasmochin  
 4 hours later—3rd thick film taken, but no injection given  
 8 hours later—4th thick film taken, followed immediately by 3rd injection of 0.03 grams of plasmochin  
 4 hours later—5th thick film taken, but no injection given  
 4 hours later—no thick film taken, 4th injection of 0.03 grams of plasmochin  
 4 hours later—6th thick film taken, but no injection given

Table I shows the results.

Of the 20 cases included in Table I, 15 still showed ring forms (schizonts) of the parasites in the peripheral blood 28 hours after treatment was started—9

TABLE 1  
 SERIES OF 20 CASES TREATED WITH PURE PLASMOCHEN

Case No.	Film No. 1		Film No. 2		Film No. 3		Film No. 4		Film No. 5		Film No. 6	
	Leuco.	Para-sites	Leuco.	Para-sites	Leuco.	Para-sites	Leuco.	Para-sites	Leuco.	Para-sites	Leuco.	Para-sites
1	200	10	200	15	200	12	200	7	200	4	200	2
2	200	20	200	35	200	32	200	18	200	14	200	15
3	200	25	200	82	200	90	200	63	200	47	200	83
4	200	16	200 1,200	200 1,500	200	350	200	150	200	230		
5	200	5	200	50	200	48	200	45	200	35	200	16
6	200	3	200	25	200	18	200	22	200	15	200	10
7	#	2	#	18	#	10	#	12	#	5	#	2
8	200	20	200	109	200	80	200	76	200	50	200	20
9	200	21	200	27	200	10	200	2	#	0	#	0
10	#	2	#	5	#	0	#	0	#	0	#	1
11	#	5	200	520	200	120	200	184	200	330	200	8
12	200	108	200	12	200	4	200	3	#	0	#	0
13	200	30	200	58	200	25	#	4	#	0	#	0
14	200	16	200	7	200	5	200	11	200	17	200	35
15	200	54	200	89	200	44	200	73	200	33	200	1
16	200	50	200	208	200	105	200	87	200	130	200	70
17	200	18	200	60	200	50	200	43	200	24	200	20
18	200	5	#	0	#	0	#	0	#	0	#	0
19	#	2	#	10	#	18	#	6	#	14	#	4
20	200	4	200	6	200	2	200	0	200	0	200	0

\*Entire smear was examined.

had a greater number of parasites than at the beginning; while in 4 cases they were less numerous than before treatment was instituted. The most remarkable feature noted during the investigation was the increase in the number of parasites 4 hours after the initial dose of pure plasmochin, which was observed in 17 out of the 20 cases. As the treatment was begun as soon as the diagnosis was established, regardless of the cycle of the parasite (before, during and after the febrile paroxysm), it appears probable that this increase was due to the action of the drug. We could not observe any difference between the cases which received plasmochin for the first time, and those which had been treated with the drug on previous occasions.



## CLINICAL CONTROL CASES

Oral administrations of quinine sulphate were given over a period of 24 hours to a control series of 20 cases, each receiving four 10-grain doses (a total of 40 grains). From each case, 4 thick-blood films were taken and examined—i.e., a thick film was taken 4 hours after each dose was administered.

Table II shows the results.

TABLE II  
SERIES OF 20 CASES TREATED WITH QUININE SULPHATE

Case No.	Film No. 1		Film No. 2		Film No. 3		Film No. 4	
	Leuco.	Para- sites	Leuco.	Parasites	Leuco.	Parasites	Leuco.	Parasites
1	200	183	200	5	§	0	§	0
2	200	50	200	10	200	5	§	0
3	200	2	§	0	§	0	§	0
4	200	450	200	250	200	100	200	15
5	200	175	200	105	200	70	200	5
6	200	+	200	+	200	250	200	50
7	200	185	200	250	200	86	200	12
8	200	280	200	88	200	32	200	10
9	200	173	200	185	200	28	§	0
10	200	176	200	76	200	10	200	2
11	200	50	200	10	200	2	200	1
12	200	25	200	3	§	0	§	0
13	200	4	§	0	§	0	§	0 (1 C)
14	200	4	200	2	§	0	§	0 (1 C)
15	200	10	200	6	200	3	§	0
16	200	2	§	0 (1 C)	§	0 (1 C)	§	0
17	200	25	200	20	§	8	§	0 (2 C*)
18	200	4	200	1	§	0	§	0
19	200	+	200	+	200	150	200	10
20	200	25	200	10	200	4	§	0

+ indicates more than 500 parasites for 200 leucocytes.

§ indicates that the entire smear was examined, with negative results.

C indicates presence of crescents.

C\* indicates presence of two crescents for 200 leucocytes, although the entire smear was examined.

Of the 20 cases included in Table II, 12 showed no ring forms (schizonts) in the peripheral blood 28 hours after the treatment was started while the remaining 8 showed a considerable decrease in the number of parasites. Only 2, out of the total of 20 cases, showed a slight increase in the number of parasites 4 hours after the initial dose of quinine.

## SUMMARY

Without attempting to offer even a theoretical explanation of the rather remarkable action of plasmochin alone upon the schizonts of estivo-autumnal malaria, it would appear that these observations give further support to the rationality of the routine method of treatment adopted by the Medical Department: *Plasmochin should always be administered in combination with large doses of quinine*; and especially during the first few days of treatment, when parasites are still numerous in the peripheral blood.

## FURTHER STUDY OF THE BLOOD IN BLACKWATER FEVER

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In a previous report, one of us<sup>1</sup> has given the results of studies of the blood in blackwater fever. In the first year of that work, blood for chemical examination was carried back to Washington, and the examinations were made there. Some irregular results indicated that this material was not entirely satisfactory for the chemical estimation of all constituents of the blood; and in the next year's work certain of the chemical determinations were made at the time the blood was taken; blood for other determinations being carried back to Washington and the analyses made there. In the meantime, the methods of preserving blood by the use of sodium fluoride, and of making chemical examinations of these preserved bloods, had been improved, as published by one of us.<sup>2</sup>

The plan followed in the work reported here was for one of us (W.) to carry out in the field the determinations of those substances that could not be preserved, and to collect and preserve the blood and send it promptly to the other one (R.) in Washington, where the other chemical determinations were made. This gave us two advantages: most of the chemical examinations were made by a biochemist working in his own well equipped laboratory, and it left the man in the field much more time for the collection of data and for other and collateral studies.

The determinations of the carbon dioxide combining power of the plasma, and the van den Bergh tests, were made in the field, as soon as the blood was taken. Material for all other chemical determinations was sent back to Washington, and the determinations were made there. It was planned that the inorganic phosphorus determinations would be made in the field, as it had been found impossible to prevent changes in the readings for inorganic phosphorus in preserved blood. However, the findings for inorganic phosphorus were too irregular to be of any value (possibly because of the very dusty atmosphere at the laboratory which was on land that had been filled in by dredging from the Bay); so we have no determinations of inorganic phosphorus to report.

The blood for the analyses carried out in Washington were collected in Kimble venules containing 10 mgm. of sodium fluoride per ml. of blood, and were kept on ice until they reached Washington and were examined. The analyses were made within 10 to 15 days after the time of collection. Since we had previously determined that bloods collected in this manner do not undergo changes in the chemical constituents determined within this time, we believe that the blood

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1. Whitmore, E. R.: The Blood in Blackwater Fever. Sixteenth Annual Report, Medical Department, United Fruit Company, 1928, page 123.

2. Roe, J. H., Irish, O. J., and Boyd, J. I.: The Preservation of Blood for Chemical Analysis by the Use of Sodium Fluoride. Jour. Biol. Chem., 1927, 75, 685.

chemistry determinations made in Washington are correct within the limits of the experimental error of the laboratory.

Brief notes of the cases, the condition at the time the blood was taken, and the findings in each case, are as follows:

R. D., #12. 40-year-old man. Salvador. Had blackwater fever  $3\frac{1}{2}$  years ago. Developed blackwater in the hospital. Blood for chemical examination taken 2 hours after the patient passed the first black urine. The urinary secretion was good. The urine was dark reddish-brown, with hemoglobin, but no red blood cells. The urine continued dark for 43 hours after the blood was taken. The blood chemistry showed an elevation of the nonprotein nitrogen, which was 61 mgm. per 100 ml.; and of the urea nitrogen, which was 40 mgm. per 100 ml. The other blood chemistry determinations were normal. These findings indicate nitrogen retention resulting from impaired kidney function.

Blood for  $\text{CO}_2$  combining power and van den Bergh on plasma was taken  $29\frac{1}{2}$  hours after the beginning of blackwater. The urine was dark reddish-brown mahogany color, with very marked hemoglobin reaction at the time the blood was taken. There were no red blood cells in the urine. The plasma was yellowish-brown in color.

Carbon dioxide combining power of the plasma: 49 ml. carbon dioxide per 100 ml. plasma.

van den Bergh on part of the plasma taken for  $\text{CO}_2$  combining power.

Direct: negative.

Indirect: positive; 5.77 mgm. bilirubin per 100 ml. of plasma.

van den Bergh on serum from blood taken  $6\frac{1}{2}$  hours after blood was taken for  $\text{CO}_2$  combining power.

Direct: negative.

Indirect: positive; slightly stronger than in the plasma.

Kahn test positive (four plus) on this serum.

J. M., #18. 21-year-old man. Honduras. Had blackwater fever 3 years ago. Entered the hospital with blackwater. Blood for chemical examination taken 22 hours after the blackwater started. The urine was dark, with hemoglobin, but no red blood cells. The urine continued dark for over 48 hours after the blood was taken. Involuntary urinations made it impossible to say how much urine was passed. The blood chemistry was as follows, per 100 ml. of blood: nonprotein nitrogen, 71 mgm.; urea nitrogen, 38 mgm.; uric acid, 6.0 mgm.; other determinations normal. The elevation of the blood uric acid as well as the urea nitrogen and the total nonprotein nitrogen presents a typical blood picture of an acute nephritis.

Blood for  $\text{CO}_2$  combining power was taken 43 hours after the beginning of blackwater. The urine was red, with a marked reaction for hemoglobin at the time the blood was taken. The urine was still dark, and positive for hemoglobin, 24 hours after the blood was taken. No red blood cells in the urine. The plasma was yellowish-brown in color.

Carbon dioxide combining power of plasma: 48.5 ml. carbon dioxide per 100 ml. of plasma.

van den Bergh on part of plasma taken for  $\text{CO}_2$  combining power.

Direct: negative.

Indirect: positive; 11.19 mgm. bilirubin per 100 ml. of plasma.

van den Bergh on serum from blood taken  $4\frac{1}{2}$  hours after blood was taken for  $\text{CO}_2$  combining power.

Direct: negative.



Indirect: positive; slightly less than in plasma.  
The Kahn test was positive (four plus) on this serum.  
The patient died.

R. P., #23. 23-year-old man. Spain. Never had blackwater. Developed blackwater in the hospital. Blood for chemical examination was taken 23 hours after the first black urine was passed. The urine was still red at the time the blood was taken, but was clear 20 hours later. The urinary secretion was good. The blood chemistry was as follows, per 100 ml. of blood: nonprotein nitrogen, 49 mgm.; urea nitrogen, 23 mgm.; uric acid, 4.5 mgm.; the other findings were normal. The blood chemistry of this case shows nitrogen retention, but not as severe as in the two previous cases. The urinary secretion was good, which agrees with the finding of mild nitrogen retention.

J. G., #25. 28-year-old man. Honduras. Never had blackwater. The patient developed blackwater fever in the hospital, after a dose of quinine. Blood for chemical examination was taken 6 hours after the patient passed the first black urine. The urine was reddish in color  $4\frac{1}{2}$  hours after the blood was taken, but was clear 6 hours after the blood was taken. Urinary secretion was good. The blood chemistry was normal, except the nitrogen constituents, which were as follows per 100 ml. of blood: nonprotein nitrogen, 64 mgm.; urea nitrogen, 32 mgm.; uric acid, 4.3 mgm. This is another case of moderate nitrogen retention, which is in agreement with the clinical observations of mild hemoglobinuria and good urinary secretion.

Blood for the van den Bergh test was taken one hour after the passage of the last red urine; the urine passed  $\frac{1}{2}$  hour after the blood was taken was clear. The serum was brownish-yellow.

van den Bergh on the serum.

Direct: negative.

Indirect: positive; 5.19 mgm. bilirubin per 100 ml. of serum.

A. G., #20. 20-year-old man. Honduras. Never had blackwater. Patient entered the hospital with blackwater. Blood for chemical examination was taken  $2\frac{1}{2}$  days after the patient passed the first black urine. The urine was still red at the time the blood was taken, but was clear 36 hours later. The urine was very scant up to the time the blood was taken; secretion became good later during that day. The blood chemistry of this patient showed a marked elevation of the nonprotein nitrogen constituents. These were as follows, per 100 ml. of blood: nonprotein nitrogen, 149 mgm.; urea nitrogen, 72 mgm.; uric acid, 10.4 mgm.; creatinine, 3 mgm. The other blood constituents were normal. The severe nitrogen retention here is in agreement with the scant urinary secretion. This is the first of our cases showing an elevation of the blood creatinine, a finding characteristic only of advanced nephritis.

Blood for van den Bergh was taken 4 days after the beginning of the blackwater. The urine was scanty, and gave a strongly positive reaction for hemoglobin at the time the blood was taken. There were no red blood cells in the urine. The serum was brownish-yellow.

van den Bergh on the serum.

Direct: negative.

Indirect: positive, 4.17 mgm. bilirubin per 100 ml. of serum.

L. V., #2. 23-year-old man. Honduras. Never had blackwater. The patient entered the hospital with blackwater. Blood for chemical examination was taken 48 hours after the blackwater began. The urine was very scant; red in color. The patient was vomiting. The urine continued red for 12 hours

after the blood was taken. Catheterization yielded 20 ounces of red urine 12 hours before the blood was taken; no more urine until 14 hours after the blood was taken, when catheterization yielded 4 ounces of red urine. This case showed the most severe nitrogen retention of any in our series. The blood chemistry was as follows, per 100 ml. of blood: nonprotein nitrogen, 182 mgm.; urea nitrogen, 125 mgm.; uric acid, 9.1 mgm.; creatinine, 6 mgm.; the other constituents were normal. The high nonprotein nitrogen, with a creatinine of 6 mgm. per 100 ml. (above 5 mgm. creatinine per 100 ml. is generally considered a fatal prognosis) indicates that a very severe nephritis existed.

Blood for CO<sub>2</sub> combining power was taken 92 hours after the blackwater began, and 7 hours after the first clear urine was obtained by catheter. In the 57 hours up to the time the blood was taken, 27 ounces of urine had been obtained by catheter, and the patient passed 7 ounces of urine 9 hours after the blood was taken. The patient was vomiting frequently, and was being

TABLE I

Patient	Days Standing Before Analysis	Non-protein Nitrogen	Urea Nitrogen	Uric Acid	Creatinine	Sugar	CO <sub>2</sub> Combining Power	Calcium	Cholesterol	Lecithin	Bilirubin	Total Phosphorus
R. D. # 12	10	61	40	3.6	1.1	57	49	10.4	178	282	indir. 5.77	35
J. M. # 18	10	71	38	6.0	1.3	112	48.5	8.7	114	149	indir. 11.19	34
R. P. # 23	15	49	23	4.5	—	82	—	—	182	237	—	—
J. G. # 25	15	64	32	4.3	—	113	—	10.	150	195	indir. 5.19	—
A. G. # 20	14	149	72	10.4	3.0	107	—	9.5	125	171	indir. 4.17	22
L. V. # 2	14	182	125	9.1	6.0	128	35	—	160	290	—	24
Normals	—	25-35	10-15	1-4	1-2	65-110	50-75	9-11	160-200	240-300	0-0.6	25-40

given glucose solution intravenously and in the Murphy drip, and physiological salt solution subcutaneously; and the obtaining of the blood was delayed to avoid taking it too close to the time of some of this medication. The plasma was straw color.

Carbon dioxide combining power of the plasma: 35 ml. per 100 ml. of plasma.

Following this determination the patient was given rather large doses of sodium bicarbonate, and the urinary secretion was reestablished; but the patient did not cooperate, and refused—and even resisted—food and treatment. He died a few days after the urinary secretion was reestablished.

The results obtained in the study of this series are tabulated in Table I.

Of the twelve substances determined, the sugar, calcium, cholesterol, lecithin, and total phosphorus, may be said to be normal findings. The 57 mgm. and 128 mgm. blood sugar values for case 12 and case 2 are not considered significant,

since the normal blood sugar concentration is 65 to 110 mgm. per 100 ml. for the method use (Benedict's new method). (Case 2 was receiving intravenous glucose, the blood being taken several hours after a glucose injection.)

Of the four calcium determinations, three are within the normal limits of 9 to 11 mgm. per 100 ml.; and no significance can be attached to one value of 8.7 mgm., which is slightly below normal. The normal cholesterol content of the blood when determined by Bloor's method, which we used, ranges from 160 to 200 mgm. per 100 ml. The findings reported in the table are within this range, except cases 18 and 20, which are low. The values for lecithin are also within normal limits, with the exception of cases 18 and 20. We do not attach any significance to the low lipid content of the bloods of these two cases, as the other four cases are well within normal limits. The four values reported for the total phosphorus of the blood are considered normal findings.

The values for the nonprotein nitrogen of the blood, and its fractional constituents, show a definite elevation of these substances. The nonprotein nitrogen and urea nitrogen are increased in all of the cases; the uric acid values are higher than normal in five of the six cases; and the creatinine is elevated in two of the cases. An elevation of the nonprotein nitrogen constituents of the blood might result from an increased catabolism of protein or a reduced capacity of the kidneys to excrete nitrogen. The latter condition is apparently the one that exists in blackwater fever. It may be true that in blackwater fever there is probably some disturbance of protein metabolism due to the severe hemolysis that occurs, but this is not a likely explanation of the nitrogen elevation. What seems more probable is that there is kidney incapacity, which is most conspicuously indicated by the fact that the urinary secretion closely parallels the nitrogen retention. When the urinary secretion is fairly good, the nitrogen retention is mild; when the urinary secretion is scant, or there is urinary suppression, the nitrogen retention is more severe. These observations indicate that the elevation of the circulating level of nonprotein nitrogen is due to the inflammatory changes in the kidneys which interfere with excretion, and that an acute nephritis therefore exists during attacks of blackwater fever. Whipple<sup>3</sup> reports the occurrence of acute nephritis in blackwater fever, from the post mortem findings in the kidneys. But, while Whipple says that acute nephritis is not a constant finding in blackwater fever, our studies indicate that there is always nitrogen retention, even in cases in which the further progress is to recovery.

The determinations of the CO<sub>2</sub> combining power of the plasma show that in two cases the values obtained were just below the lower normal limit; practically the same as the determinations last year. In the third case there was definite reduction of the CO<sub>2</sub> combining power of the plasma; and in this case urinary secretion was reestablished when alkali treatment was used.

The use of a cobaltous sulphate standard for the determination of bilirubin,

3. Whipple, G. H.: The Pathology of Blackwater Fever. *Amer. Jour. Trop. Med.*, 1927, 7, 1.



according to the procedure recommended by McNee and Keefer,<sup>4</sup> made it possible to satisfactorily carry out this determination under the conditions in the field in the tropics. It is interesting that in all of the cases tested, the direct van den Bergh was negative, while the indirect was strongly positive, reaching a high figure in one case. In all cases the serum was allowed to stand mixed with the diazo reagent for one hour before the addition of alcohol which was necessary to produce the indirect reaction. It is not our intention to enter into a discussion of the conditions under which the direct or indirect van den Bergh occurs. M'Gowan<sup>5</sup> says that the bilirubins present in hemolytic and obstructive jaundice are essentially identical, so the difference in the reaction must be due to differences in the medium; and he thinks diminished alkali reserve of the blood is the basis of the appearance of the indirect van den Bergh reaction. In two of our cases the CO<sub>2</sub> combining power of the plasma was determined, and the van den Bergh was done on a portion of the same plasma, being checked shortly afterward on the serum. In these two cases the CO<sub>2</sub> combining of the plasma was so little below the lower normal limit as to be of no significance; yet the direct van den Bergh was negative, while the indirect was strongly positive, in both cases—the bilirubin content being very high in one case.

#### REMARKS

Our material is too small to warrant the drawing of any conclusions; but we feel that we have worked out our plan of procedure to where we have a satisfactory method of carrying on these newer studies on blackwater fever; and we can continue with the collection of data. Our results indicate that nitrogen retention is very commonly—if not generally—present; indicating disturbance in the secretory activity of the kidneys; and that this nitrogen retention may be so marked as to give the blood chemistry picture of an acute nephritis. This is in accordance with the post-mortem finding of acute nephritis in some of the cases of blackwater fever. In our results so far there is no evidence of any marked deviation from the normal in any of the other chemical constituents of the blood; notably, sugar, calcium, cholesterol, and lecithin.

The work is being continued.

4. McNee, J. W., and Keefer, C. S.: The Clinical Value of the van den Bergh Reaction for Bilirubin in Blood. *Brit. Med. Jour.*, 1925, 2, 52.

5. M'Gowan, J. P.: Alkali Reserve of Blood in Relation to van den Bergh Bilirubin Test. *Edinburgh Med. Jour.*, 1930, 37, 28.

## OBSERVATIONS ON MALARIA IN THE PANAMA DIVISION, 1930

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Malaria parasite surveys were made in the Panama Division to obtain information as to the present rate, and to compare it with rates obtained during surveys made in 1928 and in 1929. These surveys offered a unique opportunity for comparing the malaria rate for three successive years in a comparatively stable and homogeneous population in the tropics. Thick films were used in all three surveys, and little error is introduced by difference in personnel, as the author assisted Dr. M. A. Barber, formerly Special Expert, U. S. Public Health Service, under whose direction the previous surveys were made, in the examination of the specimens, and in 1930 examined them all himself. The results of the three surveys are shown in Table I.

TABLE I  
COMPARISON OF COMPANY CAMPS SURVEYED IN 1928, 1929, AND 1930

Locality	1928			1929			1930		
	No. exd.	No. Pos.	% Pos.	No. exd.	No. Pos.	% Pos.	No. exd.	No. Pos.	% Pos.
One-Mile . . . . .	407	35	8.6	62	10	16.1	100	12	12.0
Dos Canos . . . . .	103	42	40.8	56	22	39.3	48	12	25.0
Base Line School. . . . .	65	17	26.1	49	13	26.5	44	11	25.0
Feild's . . . . .	40	12	30.0	53	14	26.4	33	20	60.6
Chase. . . . .	Not examined			50	18	36.0	45	13	28.8
Olivia. . . . .	Not examined			33	7	21.2	33	13	40.0
Margarita. . . . .	33	7	21.2	75	35	46.6	39	16	41.0
Chiriquicito . . . . .	33	18	54.5	80	56	70.0	66	11	16.6
Guabito. . . . .	185	50	27.0	100	18	18.0	92	16	17.4
Totals . . . . .	1029	214	20.8	575	185	32.2	500	124	24.8
Children's Rate . . . . .	450	107	23.7	261	91	34.8	229	63	27.5

Several items strike the eye in this comparison. First, it should be noted that the very high rate (60.6%) in Feild's Camp is due to the fact that 7 of the 20 positives were found in one family which had moved in recently from Suretka, an outlying abandoned camp in which no sanitary work or camp treatment had ever been done. Second, the spectacular reduction in rate at Chiriquicito. That this is an actual reduction, and not due to a change in the population examined, is evidenced by two things. A survey had been made by the Almirante Hospital staff in November, 1929, when a rate of approximately 19 per cent was found. The individual records of 28 persons who were examined in 1929 were compared with their records in 1930. Twenty-one of these 28 were positive in 1929, and only 8 in 1930.

As a general rule, camps that had a high rate in 1929 remained high in 1930, with the exception of Chiriquito.

Among 124 positives found in 1930 the following percentage incidence of types of malaria parasite occurred: Estivo-autumnal (*P. falciparum*) 85.4 per cent.; Quartan (*P. malariae*) 13.0 per cent.; Benign Tertian (*P. vivax*) 1.6 per cent. Heavier infections, that is, those showing one or more parasites per thick-film field, were slightly higher in the 1930 survey than in 1929, the figures being 36.2 and 28.0 per cent, respectively. Noteworthy is the almost complete absence of tertian infections. In 1928 the percentage of tertian was 9.1; in 1929 it was 10.8, and in 1930, it was only 1.6. That this is an actual decrease and not an apparent one due to the examiner's personal equation is shown by the following table of routine blood examinations made by the same hospital technician at Almirante Hospital in 1927, 1928 and 1929.

TABLE II  
DECLINE IN TERTIAN MALARIA IN THE PANAMA DIVISION

	1927	1928	1929
Examinations. . . . .	6106	7537	2953
Estivo-autumnal . . . . .	1033	1980	483
Tertian . . . . .	526	114	34
Quartan . . . . .	39	77	20
Mixed. . . . .	44	25	15
Total Positives . . . . .	1642	2195	552
Per cent Tertian . . . . .	32.0	5.2	6.1

It is interesting to speculate upon how much of this decline in tertian is due to the effect of large-scale camp treatments with plasmochin and quinine, begun in 1928, upon the parasites of *P. vivax*. Are they more susceptible to treatment than those of the other types?

*Incidence of Gametocyte Carriers.*—The proportion of quartan gametocytes was low, only 2 slides showing them. Only 2 tertian cases were discovered, both of which were diagnosed on ring-forms only, no mature schizonts being observed. Crescents were found in 26 of the 106 estivo-autumnal positives, but only 4 of the 26 showed sufficient gametocytes to be good "prospects" for infecting mosquitoes.

*Race and Susceptibility to Malaria.*—It was thought worth while to go over the records of hospital admissions for malaria at the Almirante Hospital, during the past three years, to determine the number of cases requiring hospitalization for malaria, contributed by the two main elements of the population. An interesting condition was found, from which a prediction can be made. The following table (Table III) gives the number of cases with primary diagnoses of malaria, admitted from the Company camps to the hospital during 1927, 1928, and 1929, according to race.

This table shows that the settled, stable, well-fed Jamaican labor contributes approximately only 50 per cent of the serious malaria in the division, notwith-



standing the fact that the Negro forms 85 to 90 per cent. of the total population. The Latin-American element, far outnumbered, nevertheless forms half of the hospital cases of malaria. Upon inquiry, it was learned that as the Negro laborer leaves the Division for work elsewhere, his place is taken by Latin-Americans, whose resistance to the effects of malaria is so much less than that of the Negro. Therefore it may safely be predicted that as the racial composition of the labor population changes, the malaria rate will rise. Efforts should therefore be redoubled to eliminate the insect vectors of the disease, and to prevent mosquito infections by sterilizing carriers with small doses of plasmochin.

There has been a marked decline in hospital admissions during the summer and fall of 1929, until the smallest number ever receiving hospital care was reached in January, 1930, when only 8 patients were in the hospital. During previous years, the admissions for malaria alone average quite uniformly about 30 per month. This decline began before any change in hospital administration had been made (Dr. Brosius left Almirante late in September) and continued uninterruptedly with little fluctuation until the end of the year. The decline in number of cases admitted for malaria went *pari passu* with the decline in total

TABLE III  
MALARIA HOSPITAL ADMISSIONS ACCORDING TO RACE

	1927	1928	1929
Total . . . . .	384	461	265
Negro. . . . .	249	235	132
Per cent Negro . . . . .	64.8	50.9	49.8

numbers of patients. This decline was not due to any marked decrease in number of employees, as the records show that only about 200 fewer persons were on the Company's books at the beginning of 1930 than in 1929, in a total number of about 3,000. Undoubtedly a portion of this decline in hospital malaria may be attributed to the short-radius sanitation so well carried out in many of the camps of the Division, and supplemented by camp treatments of all fever cases with quinine and plasmochin.

*Influence of Climate on Malaria Admission Rate.*—Rainfall records for the past three years were charted against the number of admissions for malaria during the same period of time. No significant correlation appears. The twin peaks of rainfall occur normally in May-June-July and in November-December-January, while the greatest number of admissions for malaria occurs in late spring, as a rule, although the fluctuations in this respect are not great. If this late spring incidence were due to an increase in transmission, it should take place about a month or six weeks after the beginning of the rainy seasons. This, however, is not the case. The absence of any sudden changes in rate throughout the year reflects the endemic character of the disease in this Division, and gives hope that continual pressure against the vulnerable links of the chain of transmission may result in a slow but steady decline in the field parasite rate.

*Dissections of Anopheline Mosquitoes Caught in Houses.*—Mosquito collections were made in various camps as opportunity permitted. Two collections were made in quarters in Margarita Farm at different times. A total of 66 *Anopheles albimanus* was taken, 59 of which were dissected. Stomachs only were examined, and none was found positive. Seventeen *A. albimanus* and 4 *A. punctimacula* were taken in houses at "Long Range," west of Guabito, and all dissected, and found negative. This is not surprising, as the survey at Margarita did not

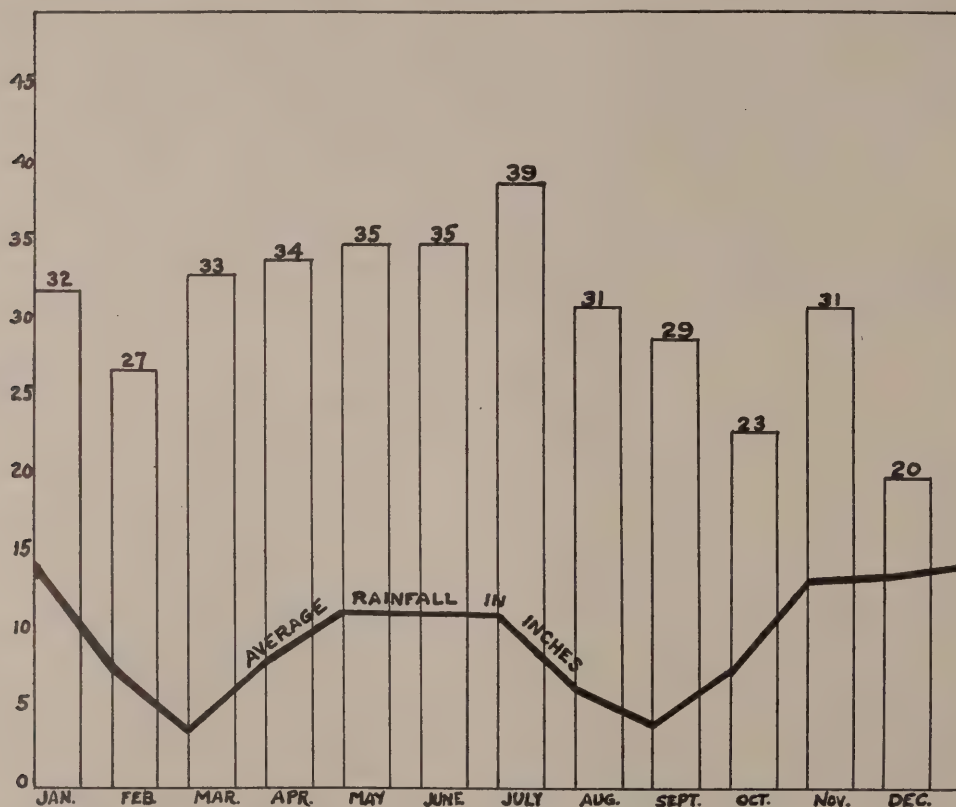


CHART I.

AVERAGE RAINFALL FOR THE DIVISION, 1927-1928-1929, PLOTTED AGAINST AVERAGE NUMBER OF HOSPITAL ADMISSIONS FOR MALARIA DURING SAME PERIOD

disclose a single good carrier; and the rate at Guabito was comparatively low, only 17.4 per cent.

*Observations on Malaria-Control Operations in 1930.*—In July, 1929, a full-time sanitary inspector was assigned to the Panama Division. He was furnished with a railroad motor-car, and two Negro helpers. He had been instructed in the technique of distribution of Paris green dust by Sanitary Inspector J. A. Corrigan, of the Company's force. After getting a good start in the mosquito-control work, the epidemic of smallpox which threatened the Division by spread from the region of the Canal Zone and Panama City necessitated his being employed

in wholesale vaccination of Company employees during the greater part of the fall. During this time it was impossible to devote sufficient attention to the anti-larval work in the Division. To determine the amount of time required for covering the Division and doing the required Paris green applications, a number of camps were visited with Mr. Corrigan, the Sanitary Inspector, and Dr. H. M. Walker, Acting Superintendent of the Almirante Hospital. It was found that with a good motor-car and two efficient helpers, the principal breeding-places in the Division could be completely covered in the required interval of seven days. In the course of the visit, house catches were made at a number of camps. In every camp it was possible to find engorged *Anopheles* mosquitoes, but their numbers were comparatively small in all camps except Margarita. The cause of the trouble here was found in the old river-bed of the Sixaola River about a mile from the camp, where enormous numbers of *A. albimanus* larvae were breeding among mats of *Nitella* in the shallow water. If mosquito control is to be obtained at this camp, it will be necessary to treat this whole area carefully and completely every seven days. A very excellent diluent for Paris green was found in the thin layer of fine silt on the banks of this river-bed, so that the problem of control is not so great as would at first appear.

At Feild's Camp the mosquito rate was fairly high. In the quarters housing the family from Suretka, mentioned above, which had the high parasite rate and two good crescent carriers, eleven mosquitoes were found, the highest number taken in any house in the camp. A mosquito-breeding survey of the terrain around the camp was made, and extensive and inaccessible breeding-areas found in neighboring lagoons. Mr. Corrigan is of the opinion that intensive medical treatment offers the only hope of malaria control in this camp, with which the writer agrees.

At Chase Camp, no serious problem was found, as the Sixaola River at this point is swift, and side-pools and dead water are infrequent. The small stream running behind the camp was examined for mosquito larvae, but none but a few larvae of the stream-breeding Anopheline, *Chagasia bathanus* Dyar, was found.

*General Considerations on the 1930 Season.*—Judging from the amount of standing water in and about the camps surveyed, the month of January 1930 was much drier than the same month in 1928 and 1929. This was particularly noticeable in Farm Four, where the extensive swampy areas in the pasture near the camp were nearly completely dry; only one *A. albimanus* was caught in that camp. Similar conditions existed in the wet pasture-land at Wenham's Farm, south of One-Mile Camp, which in 1928 was a heavy producer. In this year we captured over 30 *A. albimanus* on two different occasions, in and under the farmhouse at this place. In 1930 only 1 *A. albimanus* was found on one occasion, and none at another examination. This excessively dry weather may have had some bearing on the possibility of covering the entire division in the required seven days' time, as under conditions of excessive rainfall and consequent widespread breeding, an emergency force may have to be employed to take care of breeding near large centers of population, such as at Guabito.



OBSERVATIONS ON MALARIA IN THE CHIRIQUI LAND CO.  
DIVISION, 1930

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Malaria surveys were made in five of the farms of the Chiriqui Land Company in the province of Chiriqui, R. de Panama. The results form an interesting comparison with the survey in the Almirante Division (p. 65), as showing the variations in rate and type in two localities on different sides of the continental divide, separated by only about 80 miles.

During construction days at Puerto Armuelles the malaria rate was very high, as no precautions were taken to prevent the spread of the disease during the early part of the work. As a result, the pioneers in this division were heavily infected with malaria, from which the later comers received the infection in due course.

TABLE I

SURVEYS OF LABOR CAMPS, CHIRIQUI LAND COMPANY, FEBRUARY, 1930

Locality	No. ex'd.	No. Positive	Per cent Positive
Pto. Armuelles . . . . .	100	31	31.0
Progreso. . . . .	100	19	19.0
Corredor. . . . .	100	46	46.0
Blanco. . . . .	100	26	26.0
Esperanza . . . . .	100	24	24.0
Totals. . . . .	500	146	29.2
Children's Rate. . . . .	98	42	42.8

The situation here is rendered more difficult also because of the high percentage of the less immune Latin-American element in the population, and also by the constant influx of migratory labor, bringing with it many cases of untreated malaria to act as foci for the dissemination of the disease.

Thick films were used in the survey, and all were examined by the writer. The results of the survey are shown in Table I.

The difference in incidence of types of malaria between this area and the Almirante Division is striking. Almirante showed practically no benign tertian malaria, while in Chiriqui the rate was 52.7 per cent of the total positives. No very high rates, as compared with the field parasite rates of the Almirante Division, were found. This is doubtless due to the efficient and thorough survey and treatment work being done in the Chiriqui Division by Mr. J. R. Maltsberger of the Medical Department.

Among the 146 positives found among 500 slides examined, the percentage incidence of types of malaria is as follows: Estivo-autumnal, 38.3 per cent; Tertian, 52.7 per cent; Quartan, 9.5 per cent. The percentage of heavy infections, showing at least one parasite per thick-film field, was slightly higher than that found

in the Almirante Division, being 40.4 per cent and 36.2 per cent, respectively. The children's rate was also much higher, 42 out of 98 children examined, or 42.8 per cent, being positive, against only 27.5 per cent of the 63 children examined at Almirante. In this connection, any person 12 years old or less is considered a child.

The proportion of gametocyte carriers was high. Crescents were found in 33 of the 56 estivo-autumnal positives, 7 of these showing sufficient crescents to make them good vectors. The number of heavy tertian infections was also high, but gametes were found in only 18 of the 77 tertian positives. Only 1 quartan positive showed the presence of gametes.

*Mosquito Breeding Survey.*—Time did not permit of a very extensive survey. My visit was in the midst of the dry season, and all but the more or less permanent breeding-areas were dry. The small stream flowing behind the new hospital building was found breeding in several places, but nothing but young larvae was observed, showing that dusting operations had been effectively done. A few *A. albimanus* larvae were found in these places. The large stream which empties into the Pacific to the east of "Rabo Puerco" was found breeding heavily in nearly all its extent, except near its mouth, where it was too heavily polluted with refuse animal matter. The mats of green algae so thick in the numerous cut-offs and side-pools were the favorite lurking-places of Anopheline larvae, but here again no large larvae or pupae were found, except in one small pool, showing that control operations had been effective. No opportunity was had to collect or dissect any adult mosquitoes in any of the camps. Most of the larvae encountered were *Anopheles pseudopunctipennis*, not usually regarded as a dangerous carrier except in the Argentine. No *Anopheles albimanus* adults were seen during my stay. It is safe to say, however, that most of the transmission of malaria takes place after the beginning of the wet season, when *A. albimanus* breeds in the numerous pasture-pools in the neighborhood of the camps.

The Paris green dusting work for larva control seemed to be very well organized, and so far as a short survey could determine, very effective. It is suggested that the larva index, as a measure of the effectiveness of this work, be supplemented by catches of adult mosquitoes at stated intervals, especially during the wet season, when an overlooked area, producing heavily, might nullify all the good work done in the remaining treated areas.

## THE PROBLEM OF CHILDREN IN MALARIA CONTROL\*

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At the request of the Health Offices of the Republic of Panama and the Panama Canal, a survey was made of the majority of the inhabitants in six villages located in the vicinity of the Chagres River between the eastern boundary of the Canal Zone and the Alhajuela hydrographic station. This examination was conducted at the height of the *rainy season* and the beginning of the *dry season*.

The inhabitants of the town of Chilibre were examined on the 10th of Sept., 1929. It is a comparatively new village, located on the ridges of two or three hills; and the houses are well scattered along these ridges in well cleared areas that afford excellent natural drainage. Many of the inhabitants are recent arrivals from Panama City.

The villages of Santa Rosa, Guayabalito and Las Huacas were examined on Sept. 19, 1929. These villages are located right on the banks of the Chagres and the inhabitants are principally people who have spent nearly all their lives in rural locations along the river. The immediate town sites are almost as clean as that of Chilibre.

The village of Gatuncillo is located at the fork of the Chagres and Gatuncillo, while New San Juan is a short distance up stream on the bank of the Gatuncillo. The character of the inhabitants and the town sites are the same as those just mentioned. These two villages were examined on December 23, 1929, and January 6, 1930, respectively.

*Survey Method Employed.*—A single thick-blood-film was made from each person and prepared for examination according to the method of Barber and Komp,<sup>1</sup> and an average microscopic search of two minutes was made of each film before it was called negative.

*Malarial Parasite Index of Adults and Children.*—The rates by villages are shown in the following tables.

ADULTS  
(Over 12 years of age)

Villages	Number Examined	No. Positive for malaria	% Positive for malaria
Guayabalito . . . . .	58	27	46.5
Santa Rosa . . . . .	84	39	46.4
Las Huacas . . . . .	30	13	43.3
New San Juan . . . . .	141	43	30.5
Gatuncillo . . . . .	26	4	15.3
Chilibre . . . . .	45	3	6.6
	384	129	33.6

\* Read before the Second Congress of the Panamerican Medical Association, Panama, R. de P., 1930.



CHILDREN  
(12 years or less of age)

Villages	Number Examined	No. Positive for malaria	% Positive for malaria
Guayabalito . . . . .	58	32	55.1
Santa Rosa . . . . .	63	38	60.3
Las Huacas . . . . .	23	11	47.8
New San Juan . . . . .	88	52	59.1
Gatuncillo . . . . .	34	14	41.1
Chilibre . . . . .	64	8	12.5
	330	155	46.9

COMBINED INHABITANTS OF THE SIX VILLAGES

	Number Examined	No. Positive for malaria	% Positive for malaria
Adults . . . . .	384	129	33.6
Children . . . . .	330	155	46.9
Total . . . . .	714	284	39.8

The parasite rate for children, in my past six years experience in Central America, and the West Indies, has always been nearly double that for adults even though they apparently live under the same conditions. Children living in rural districts, because of their scanty clothing, have more of their body surface exposed to mosquitoes than adults do; and are less apt to remain protected at night by mosquito nets, because of their habit of rolling and crawling about and thereby coming in contact with the net wall or escaping entirely from its protection. Furthermore, adults have established a relatively good tolerance to malaria; and are also more apt to be conscious of symptoms and take some form of treatment.

Rural children are less apt to complain or exhibit signs of illness than adults. They may lie down for short periods during paroxysms, but the reason for this escapes the attention of the parents. In fact, not more than a dozen of the total 284 positive individuals in the survey were bedfast or complained of an illness that would suggest an attack of malaria. The splenic enlargement was by no means constant; but there was usually a noticeable degree of anemia.

Children therefore afforded a difficult problem in malaria control measures; because of the frequently masked presence of the disease and because of the great difficulty in finding a satisfactory method for mass treatment in a community, even when a survey reveals the presence of the infection.

I believe that the mosquito index of infection in rural communities depends more on the parasite rate in untreated and insufficiently treated children than on the infected adult-population. I wish particularly to lay emphasis on this point since I think very few of the profession, not directly connected with malarial control work, realize the rôle played by children. A very small percentage of rural people, particularly in the tropics, ever seek treatment in a

dispensary or hospital for malaria; and this means that the bulk of the *seed-bed* of the disease is left in a favorable state to infect mosquitoes in unsanitated areas.

#### REFERENCE

1. Some Modifications of the Thick-Film Method in the Examination of Blood from Malaria Parasites. M. A. Barber, M.D., and W. H. W. Komp. International Conference on Health Problems in Tropical America. 1924. United Fruit Company, Boston, Mass.

### CONTROL OF MALARIA IN THE PRESTON DIVISION

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During the last three years, 1927, 1928, and 1929, the bodies of water in the plantation of the Preston Division of the United Fruit Company have been continuously treated with mixtures of Paris green and dust, in an endeavor to destroy *Anopheles* larvae; and it may be of interest to record the effects which this procedure during a three-years period has had on the breeding of *Anopheles* in the area.

It is unfortunate that we must use the year 1929 as a basis for final comparison as the rainfall during that year was much lighter than in the two preceding years and, at first sight, the natural conclusion is that the reduction in breeding has been due to the reduction in rainfall. However, there are two other end-results to be considered which may throw a different light on the picture. These are, (a) the intensity of the breeding and (b) the number of cases of malaria occurring in the area.

It is now well known and definitely accepted that the application of Paris green mixed with dust, to a body of water which contains larvae of *Anopheles*, will result in the extermination of these larvae. The larvae are killed within a few hours after the application of the mixture, due to the fact that the larvae of *Anophelinae* are "surface feeders." They feed while they are floating horizontally on the surface of the water; and attract their food by the continuous agitation of their "mouth-brushes" (brush-like hairy processes), which causes a suction-like movement that directs the current of water towards the mouth of the larva. Particles of Paris green floating on the surface are ingested by the larva, along with their food; and they are thereby poisoned, as attested by the finding of many particles of Paris green in their stomachs upon dissection.

Recent experiments have shown that water treated with Paris green will remain toxic for anopheline larvae for a period that ranges between 2 and 6 days,

the length of the period for which it is effectual varying with the kind of dust used in the mixtures. Thus, if hydrated lime is mixed with the Paris green, the water will remain toxic to larvae for about 3 days; if calcium stearate is used as the diluent, 5½ days; and if aluminum stearate is used, 6 days. It is assumed that, the more insoluble and lighter the substance used as a diluent, the longer will the Paris green particles remain afloat by adhering to the particles of the diluent; and thus the period during which the water so treated remains toxic to larvae is lengthened. (cit. 1).

Swellengrebel and Doornbas, on the other hand, reach the conclusion that it is better to use a heavy diluent; as in this way the diluent sinks quickly to the bottom, and leaves a purer layer of Paris green on the surface of the water which will kill a proportionately larger number of larvae. Furthermore, it is more likely to kill the smaller larvae which, not having ingested any considerable amount of diluent, can ingest more Paris green. (cit. 2).

In the Preston Division we have been compelled by circumstances to use a variety of mixtures. Road-dust, as recommended by Barber, has been used whenever available as it seems to be the best diluent of all. However, when the supply of this material has run short, it has been necessary to resort to other materials. We have used lime alone, which is objectionable due to its irritating effects on the hands of the laborers; wood-ashes, which are also irritating to the hands; "silt," a type of dust obtained from dried sea-bottom; and saw-dust, mixed either with lime and ashes or with lime alone. Moist sand also has been tried, with the object of killing subsurface feeding larvae (*Culex*) at the same time that the anopheline larvae were exterminated; but it was necessary to desist from the use of this material as the area covered is very large and it is very cumbersome to handle, and no conclusions were reached as to its value. (cit. 3). More recently, lime mixed with saw-dust has been utilized. The advantage of this mixture is that the lime leaves a white pellicle on the surface of the water, which permits the Inspector to see at a glance which waters have been treated and to determine whether the laborers have overlooked any water.

Any of these materials used as diluent with Paris green will destroy the anopheline larvae present in water at the time of the application of the mixture. The subsequent remarks will refer to the effects which such treatment, carried on systematically and continuously for a period of years, has had on the breeding of *Anopheles* in the area so treated.

A fuller description of this region will be found in the Annual Report of the Medical Department for the year 1928 (cit. 4); and it will suffice to say here that the involved area covers 106,987 acres, of which 54,611 acres are planted in sugar-cane; that the area is well watered, although no irrigation is used; and that the average total rainfall for the past 3 years has been as follows: 1927—43.49 inches; 1928—48.00 inches; and 1929—31.73 inches.

The attempts at control have been somewhat limited by the decision to use only "short-radius" control—i.e., treat only those waters which are close to



habitations—but, in actual practice, a good portion of the water area has been covered as habitations are so close to each other that the whole territory is within “short-radius” of some camp, although there are a few isolated bodies of water which are not treated as they are just beyond the limit.

The method of operation has been as follows. The Division is intersected in all directions by railroad lines, which reach all the camps and serve to transport the sugar-cane to the mill. Two anti-mosquito squads, each consisting of one Inspector and four laborers, traveled daily over this railroad on gasoline-motor flat-cars to some point in the Division. Each squad covered approximately one half of the Division and visited each camp at intervals of 10 days. Upon reaching a camp, the Inspectors, who are well-trained in the detection and identification of larvae, searched for evidence of mosquito-breeding; while the men began immediately to spread the dust, which they do by hand, regardless of whether there were larvae present or not. During the stress of work, many adjustments have had to be made; but this is a fair description of the way in which the work has been handled. Last year (1928) one squad was assigned three-fourths of the district, and instructed to restrict their activities to Paris green applications exclusively; while the other squad attended to one-fourth of the district and, in addition to the routine distribution of Paris green were expected to eliminate as many collections of water as possible by filling and draining. Towards the end of this year (1929) one squad was eliminated, leaving only one squad to cover the entire area. This has been possible for two reasons—(1) the men have become so well trained in the work, and know the water area so thoroughly, that they can accomplish a great deal more work in a given period of time than was originally practicable; and (2) the reduction in breeding has lowered the mosquito-index, and consequently the work need not be pursued as intensely as in the earlier stages.

At the end of each day's work the Sanitary Inspectors rendered reports stating (a) which camps had been visited, (b) the water areas inspected and treated, (c) whether or not larvae were found; and, if so, whether they were small, medium-sized, or large; and (d) the relative amount of breeding as evidenced by the average number of larvae to each dip. The reports would also show the quantity of the mixture which had been distributed during the day's work, and the amount of Paris green that this represented; and indicated whether or not any oil had been used. They also contained recommendations for the permanent elimination of bodies of water and suggestions concerning measures which would facilitate and supplement the efforts of the squads.

It is after careful study of these reports, which were received and checked daily by the writer, that an attempt is hereby made to determine whether any curtailment of *Anopheles* breeding has been achieved or is possible with Paris green and dust mixtures and by the method of procedure outlined above. There is a sensible deficiency in this report—the lack of data to show the adult *Anopheles* index, which is the only conclusive means of determining the intensity of breed-

ing. However, this is not a scientific report; but is a report of work conducted under novel conditions, where the economic phase of the problem required constant consideration.

The following data are tabulations made from these reports:

	Num. of Days Squads Worked	Num. of Visits to Camps	Num. of Times Breeding Was Found in Camps	Percentage of Visits to Camps which Resulted in Find- ing Breeding Places
<i>1927</i>				
Squad "A" . . . . .	181	2,256	976	43.26%
Squad "B" . . . . .	158	1,390	839	62.53%
Total . . . . .		3,646	1,815	49.78%
<i>1928</i>				
Squad "A" . . . . .	193	1,849	948	51.27%
Squad "B" . . . . .	283	4,896	2,733	55.82%
Total . . . . .		6,745	3,681	54.57%
<i>1929</i>				
Squad "A" . . . . .	126	802	262	32.66%
Squad "B" . . . . .	277	5,191	1,631	31.41%
Total . . . . .		5,993	1,893	31.58%

It will be noticed that in 1927 the squads only worked 181 and 158 days respectively, and only visited the camps on 3,646 occasions. During that period the squads were not under the full control of the writer, and were frequently assigned to other work. Squad "B" only began to render reports in May, 1927. While one squad found breeding in 62.53% of the visits, the percentage for the two squads combined was 49.78%.

In 1928, Squad "B" worked the full normal year of 283 labor days. Squad "A" made inspections on 193 days only, and the other days were devoted to draining and filling undesirable water areas. Squad "B" had a lower percentage of "positive" inspections than for the previous year; while Squad "A" had a slightly higher percentage, which may be attributed to more careful searching as they were able to spend more time in a given locality. The percentage for the two Squads combined, 54.57%, shows a rise over the previous year.

In 1929, Squad "B" worked the full normal year of 277 labor days. Squad "A" made inspections on 126 days only, and the other days were utilized in eliminating useless bodies of water. The percentage of "positive" inspections for both Squads was 31.58%—a much lower rate than in either of the two preceding years.

It is evident, then, that the number of breeding foci in the Division have been reduced. It is, however, a debatable question as to the relative proportion of the reduction which may be attributed to the work done and to natural conditions, respectively. A comparison of the rainfall and the percentage of camps showing breeding foci would lead to the inference that the reduction in the latter has been due to the reduction in rainfall:

Year	Rainfall	Percentage of Camps Where Breeding Places were Found
1927	43.49 inches	49.78%
1928	48.00 inches	54.57%
1929	31.73 inches	31.58%

During rainy periods numerous swiftly-flowing creeks are formed, which do not provide suitable breeding places; but with the cessation of the rains these creeks dry up and a large number of pools are formed where breeding is constantly found. Furthermore, there are innumerable outdoor faucets located throughout the Division, which are supplied by pipe-lines from three dams located in the hills; and the overflow and leakage from these faucets produce numerous puddles. The writer's knowledge of the general topography and the usual conditions existing in the region, lead him to believe that a material part of the reduction in breeding foci is due to the constant application of Paris green and dust mixtures; and encourage him to expect that the favorable results will continue to be evident during a year of normal rainfall in 1930, if the work is carried on as energetically as it has been in the past.

There are two other factors which further strengthen this opinion. One is, that not only has the number of foci diminished but the intensity of the breeding has also been markedly reduced, as indicated by the fact that the reports have constantly directed attention to the progressive decrease in breeding as the work has proceeded. The second is that, whereas at the beginning of the campaign IV instar larvae, ready to pupate, were plentiful; during 1929 these were recorded rarely and most of the reports stated that only small and medium-sized larvae were found (II and III instars), and on many occasions none but a very few small (I instar) larvae were detectible.

The facts enumerated above lead to the conclusion that variation in the rainfall will cause a corresponding variation in the number of potential breeding places but will not similarly affect the intensity of the breeding, while treatment with Paris green and dust will reduce the intensity of the breeding to such an extent as to effect a reduction in the number of breeding places regardless of the rainfall. A combination of the two optimum conditions—(a) effective treatment with Paris green, and (b) diminution in the rainfall—would naturally effect the maximum reduction in both the intensity of the breeding and the number of breeding foci.

Another factor to be considered is the reduction in the malaria rate in the Division. The reduction in the number of malaria cases, in the district where the control measures have been in effect, has been remarkable; but surrounding localities, where no work has been done, have continued to be heavily infected and have even reported so-called "epidemics" of blackwater fever in spite of an equal diminution in the rainfall.

It has been satisfactorily demonstrated in the Preston Division that it is quite practicable to control malaria in a large agricultural area; and that this beneficial result can be accomplished with the expenditure of a very moderate and limited amount of money.



The malaria admission rates per thousand employees for the past 4 years—170 in 1926, 107 in 1927, 37 in 1928, and 24 in 1929—are sufficient evidence to demonstrate conclusively that the incidence of malaria has been greatly decreased during the period that the malaria-control campaign has been in effect, as a corresponding reduction in the number of cases treated in the field has also been observed.

It is a moot question as to the relative importance of (a) antilarval measures, (b) administration of quinine and plasmochin and (c) education of the people, in accomplishing the reduction; but it would seem self-evident that the antilarval measures have been a potent factor.

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### MALARIAL PREVENTIVE MEASURES AS APPLIED IN THE CHIRIQUI LAND COMPANY

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The aim of this paper is to give an intimate and somewhat detailed discussion of the problems encountered, and the methods applied, in an effort to reduce the incidence and the severity of malaria during the pioneer development of a plantation. Bearing in mind the possible consequences resulting from the alteration of any one of the contributory factors to the incidence of malaria in a given region, as pointed out by Hackett, it has been our privilege in Chiriqui to watch many of these factors being modified by changes in the flora, wild life, drainage, inhabitants, and modes of living in a large area.

#### HISTORICAL

The Chiriqui Land Company is a new banana division. It is located in a province of southwestern Panama, partly bordering on Costa Rica, and yet lies in

about the same latitude as the Orinoco river basin in Venezuela. The extinct volcano of Chiriqui is visible sixty miles back from the Pacific coast, where the headquarters, Puerto Armuelles is located on the shore of a wide crescent-shaped bay. Potentially, the productive area of the Company includes this coast land, and the higher lands back to the mountains and up to the optimum climatic limits of banana culture. From the standpoint of malaria control, our interest extends throughout this region. Practically, our intensive control measures embrace, for the present, five towns and their environs in which the Company's laborers are centralized for operating over an area of approximately a hundred-thousand acres.

Before the advent of organized agriculture in this littoral, the whole territory now under development, was covered by dense forests on gently rolling loamy land, through which flowed some fast streams and a few swift, rock-bedded rivers. Located inland were several swampy areas, extensive during the wet season from April to December, inclusive; and shrinking or entirely disappearing during the arid months of the year. The short coastal plain was traversed by lagoons and brackish swamps. The inhabitants consisted of scattered families of Spanish or Spanish-Indian origin, with probable migrations from time to time of Chiriqui Indians from the highlands. Malaria was endemic.

Early in 1926, the physical and sociological aspect of the region began to change. Preceding the Company's developments, a contracting company began constructing railways, bridges, and a dock. The population of Chiriqui province began to increase. Besides the influx from the temperate zone, laborers came from Nicaragua, Costa Rica, the West Indies, and the northern part of South America, and were employed on the construction work. The removal of trees and other vegetation bared the streams to sunlight, and borrow-pits along the railroad added to the mosquito-breeding foci in the various districts. A nucleus of Chiriqui Land Company personnel arrived about two years later; and their activities were simultaneous with, but separate from, those of the construction company. A thick-film malaria survey conducted at about this time by Dr. H. C. Clark, then Director of Laboratories and Preventive Medicine of the United Fruit Company, revealed an average regional infection rate of 35.6%; with the port headquarters showing the alarming percentage of 56.8%. A Sanitary Inspector began the organization of a sanitary force; and, in the last months of 1928, the first divisional survey was completed, with treatment of the apprehended "carriers." Since that time, four complete divisional blood surveys have been made; consisting of 23 individual district surveys. A total of 8,026 examinations were made; and 1,718 were found positive and treated, independent of the treatments given in the Hospital and district dispensaries.

The handicaps with which we had to cope during the first months of the organization period were almost insurmountable. Personal transportation was difficult; and, for a sanitary crew or a malarial survey force, thoroughly discouraging. Labor turnover was rapid, making it difficult to follow up individual

case treatments for a reasonable period of medication. Living conditions were poor; open manaca shelters were numerous along the railroad; fresh vegetables, fruits, and fresh meat were hardly available in sufficient quantities to prevent deficiency disturbances; a heavy rainy season added to the difficulties; and, finally, police supervision and discipline was inadequate or wholly lacking. A little later we felt the effect of a sort of medical sabotage. A practitioner, speaking the idiom of the people, came in and began telling them of the "heating nature" of quinine; and, instead of this medicine, offered them large injections as infinitely preferable. Under these odds, we had to struggle to maintain prestige until this undesirable influence was counteracted.

Better conditions came in gradually with the late 1928 dry season. Improved transportation facilities have been available since the construction company completed their operations at the end of the year. Labor is becoming more stabilized with the improvement of living conditions. Permanent villages have been constructed for the labor force, and proper food is now available. Cooperation has led to a splendid system of discipline and control by the native police, which makes it possible to survey and treat populous districts.

#### CONTROL PLAN: ANTI-LARVAL MEASURES AND TREATMENT OF HUMAN CARRIERS

The plan of control adopted in this division includes the major defensive methods of anti-larval and ultimate anti-mosquito measures, enforced by the sanitary unit; and malaria reduction by means of frequent field blood-surveys of labor units and resident groups, with treatment of all those found infected. Spleen-surveys have not been carried out, and the defensive measures of quinine prophylaxis and screening of quarters have not been applied to the native population.

The medical-sanitary force is mainly concerned with the dusting of Paris green mixture or application of oil over all known potential breeding places of *Anopheles*. An experienced white man, with four native laborers, give their entire time to this work. The breeding foci of each town and its environs are extensively treated once a week with Paris green and sawdust mixture (1:100). Occasionally for lagoons, Diesel engine oil has been cut with kerosene and applied with good results. One area of standing water showing anopheline breeding seven months ago, was given this treatment, and, up to the present time there has been no recurrence of breeding. Two districts (Corredor and Esperanza) are in the process of being drained by drainage canals—a measure doubly serviceable: (a) to banana culture, and (b) to the inhibition of mosquito-breeding. Creek channels have been cleared; and a close supervision has been exercised over rain-barrels and casual watering places in the dry season. Only a little organized destruction of adult mosquitoes has been attempted. The identification of mosquito types, as indicated by larvae, has not been systematically practiced. In the partly shaded, clear water creeks about the port, dippings show numerous



larvae of the subgenus *Chagasia* (with the spatulate or terminally broadly expanded float-hairs of *bonneae* or *farjardi*, but no *bathanus* float-hairs). Some of the slightly brackish coast lagoons show larvae of the subgenus *Nyssorhynchus* (*albimanus* or *tarsimaculatus*). These two types of larvae are also found generally throughout the division, and beyond. A number of larvae agreeing with the description of *A. vestitipennis* have been collected.

#### TECHNIQUE OF A BLOOD FIELD SURVEY

Up to the present our other methods have been utilitarian—i.e., aimed at direct results, by finding and administering intensive field treatment to dangerous ambulatory malaria carriers; and hospitalizing, when necessary, those acutely ill. The technique of our survey of malaria carriers has gradually evolved by practice until, for our needs, it seems to possess maximum efficiency. Our procedure, in detail, is as follows:

The date on which a district is to be surveyed is always selected a few days after pay-day, when labor has returned to a normal degree of stability. The Superintendent and all other heads of departments carrying on work in that district are notified to instruct their laborers to report at the centre of the village after 3:00 p.m. on the date designated. In the meantime, we prepare our slides and assemble the other necessities of a survey. We find it more convenient to number the slides beforehand, with a diamond point, and then wrap them in consecutive series of fifty each. Three or four men are required for our method of procedure. We try to be on the site of the survey by one o'clock, enlist the aid of the local police, and begin the collection of blood specimens of all women, children, and camp loafers. These can usually be finished by the time set for the reporting of the workers, and the survey goes on uninterruptedly. One of us (and the racial and linguistic characteristics of the population—Spanish and West-Indian—necessitate that he possess at least bi-lingual ability), takes the name, age, description, and farm or department where each person resides or is employed, of each individual examined. This data is inscribed in a record book previously numbered and ruled. Another one of us collects the specimen. The tip of the ring finger is cleansed with alcohol on a bit of cotton, dried, and pricked with a sharp-pointed Hagedorn needle. Two or three drops of blood for thick-film are quickly placed near the end of a slide, which should not be permitted to touch or rub the subject's finger. The slide number is checked opposite the individual's name in the book, and the slide is filed in a slide-box. By this method, six hundred or more samples of blood can be collected in an afternoon. During the last six months we have added another feature to our surveys; that of giving two plasmochin compound tablets (0.01 gram each) to everyone reporting for examination. This measure, if applied to the total population of a village, can be expected, according to Barber and Komp, and Whitmore, to render the sexual forms of the parasites in the blood of the inhabitants sterile; and this makes them non-infectious to mosquitoes for a period of several days.

At any rate we feel that the procedure is justifiable if, during the following day or two we find sexual parasites in the blood films being examined. Giemsa's stain, with Barber's modified technique, is used in staining. Slides are blocked into units of thirty-eight, with squares of cardboard placed between; and all held together by an elastic band. For a staining vessel we use metal syringe boxes, which exactly meet the size requirements of thirty-seven or thirty-eight slides; and no stain is wasted. These metal boxes do not seem to alter the pH content of the staining solution. As a rule, however, we leave a solution of the stain stand in the box before putting the box into actual use. We make it a point not to allow the slides to become heated or overdried. Examination of slides extends over fifty to one hundred oil immersion microscopic fields; and the type and degree of infection of positive findings are recorded in red ink opposite the subject's name in the large survey record book. Upon the completion of the examinations a *treatment list* of the positives is made out, with ages in chronological order, and with all other descriptive data as to sex, racial and physical characteristics, occupation, etc. This sheet, of convenient-sized cardboard, is ruled like a day-book to receive the daily treatment record of medicine to be taken during the ensuing two or three weeks. One of us personally attends to this treatment, using the local dispenser and his dispensary facilities for such aid as they can give.

#### TREATMENT OF CARRIERS

Treatment for post-febrile carriers now consists of the administration of ten or fifteen grains of quinine sulphate in tablets twice daily; the amount of medication being determined by the degree of infection and the ability of the individual to work under quinization. Two 0.01 gram plasmochin tablets are given every third day as part of the routine treatment. Infants and children unable to swallow tablets are given a suspension of quinine sulphate powder in aromatic syrup of yerba santa. Plasmochin compound tablets can easily be triturated and added to this suspension to make up the desired dosage. This treatment for children has been successful. They like the taste of the syrup, which has much the same flavor as honey; and the insolubility of the sulphate in the thick syrup renders the quinine practically tasteless. This preparation is made fresh every day or two. We also give a bit of sweet "Caracas" chocolate to each child (the bars are bought by the gross—sufficient for seven hundred treatments). This dilutes, and helps the child to swallow, the syrupy suspension remaining in the mouth; where, if it remain for a few moments, the quinine particles are readily dissolved by saliva or a drink of water and produce the characteristic bitter taste. We are never put to trouble to find and treat the children. All treatments are carried out until pay-day, when irregularities occur, and the stability of labor is upset. At the last treatment, all patients are given sufficient Pink Tonic Tablets (modified Aiken's tonic) to take over a period of six days; and are requested to report to the dispensary for another six days supply when the first are all taken.



Difficulties and objections to treatment are met, even with low quinine dosage. The first three days of treatment, we find, are the most difficult; and after the third day objections are exceptional. We have several alternatives of action in regard to individuals refusing treatment. A proper approach through the parents is usually effective with the young, as long as they are within range of parental control; and the occasional woman objector may sometimes be influenced by the husband. When tact and family appeal for help are not effective, as is the case in some of the laborers, we are able to have their pay withheld until a complete anti-malarial treatment is taken. And, finally, we have the full coopera-

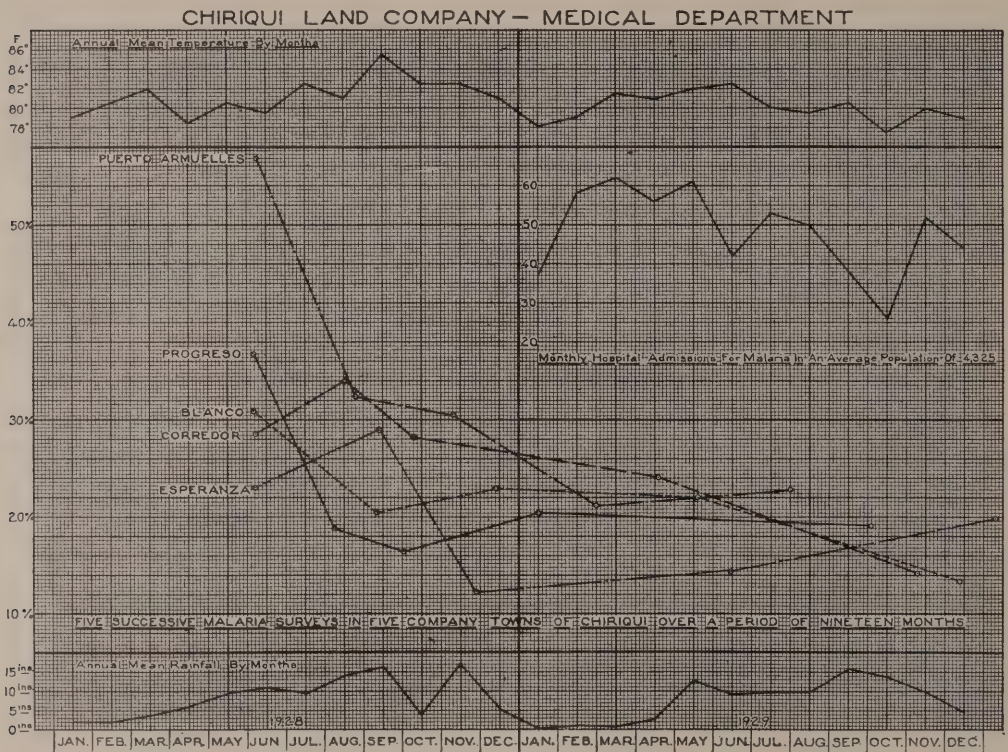


CHART 1

tion of the local police. These last measures, however, are seldom necessary. Only once during the twenty-three district surveys and the subsequent periods of prolonged treatment of positive cases have we had the pay of a worker actually stopped, and only once was it necessary for the local corregidor to impose a lecture and a fine of two pesos on a woman objector, who, thereafter took her treatment almost greedily.

The chronic anemic types we occasionally see are kept under observation for the symptoms of the precipitation of blackwater by quininization. Moderate amounts of sodium bicarbonate, given with quinine, is a routine procedure with



these types. Only four cases of blackwater fever have developed during field treatment extending over a period of eighteen months, while treating approximately 1,700 malaria "carriers."

#### CONCLUSION

This, in general, is our approach to the problem of malaria control. From a divisional average of 35.6% of infected individuals, as determined from the survey of Dr. Clark in the early days of development of the division nineteen months ago, the percentage has shown some gratifying curves downward—26.8% was the rate of infection in the September and October surveys of 1928; 21.6% in the November, December, and January tests of 1928; 20.4% in February, March, and April, 1929; and, in the last divisional survey just completed, the average infection rate in the five Company districts was 17.8%. A graphic chart illustrating the malaria curves of the individual districts, along with the temperature and rainfall averages by months for two years, appears on page 84.

Significant features challenging explanation have been brought out by these field surveys. Primarily, the infection rate of children, up to and including twelve years of age, has consistently shown an average 12% higher than that of adults. In the second place, this survey data shows a persistent increase of the prevalence of tertian malaria. There is an average decline of estivo-autumnal types from 81.1% to 48.1% of the total malarial infections. One can not say whether this decrease in estivo-autumnal infections has a meteorological basis; whether it is due to the possibility of a cure being effected in a dominant percentage of estivo-autumnal infections; or whether it is merely a transitory condition due to the operation of unknown factors.

Due to the Company's inheritance of a high malaria index, our methods, during the past eighteen months have, of necessity, been limited to emergency procedures. It is regrettable that we have been unable to investigate all of the salient factors pertaining to malaria in this region. Conditions, however, are becoming progressively better. Improved living conditions, drainage, sanitation, and medication have, no doubt, all been contributory factors. It seems that we have advanced just enough to realize that in Chiriqui there are still many legs in the journey toward "integral bonification."

## THE CONTROL OF MALARIA IN THE PRESTON DIVISION

## MALARIA ADMISSIONS TO PRESTON HOSPITAL

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The accompanying Chart (p. 87) demonstrates the reduction in the number of cases of malaria admitted to the Preston Hospital during the four-year period beginning January 1, 1926, and ending December 31, 1929. This reduction followed the application of more energetic control measures; a description of which will be found in the 17th Annual Report of the Medical Department, corresponding to the year 1928.

The Chart describes a weekly curve for the four-year period and represents the percentage of the labor population, which was found to harbor malarial parasites on admission to the Hospital, irrespective of the complaint for which they were admitted. The curve was so charted—i.e., based on the weekly labor census as reported weekly by the Agricultural Department—because the population of the Division varies markedly from the crop season to the non-crop or “dead” season; and a curve based on the total admissions only would not have given the correct impression. During the crop, as many as 6,000 new laborers enter the Division; and these are mostly cane-cutters, who leave at the end of the crop.

The Agricultural Department’s labor census was used as a basic figure, as it contained the most constant and accurate data available; and, since our object was to obtain a comparative curve from year to year and not the actual Division percentage, such figures could be conveniently used as a “yard-stick.”

The outstanding feature of the curve is the fact that, during the first three years, 1926, 1927, and 1928, there are two definite peaks occurring with absolute regularity. During 1929 these two peaks are hardly perceptible, although present.

In 1926, 1927, and 1928, the first peak occurred invariably on the third week of March, which happened to be the dryest month of each year. In 1929, what would correspond to the peak, although hardly a perceptible one, occurred in the second week in March. This peak reached 1.4% of the labor population in 1926 (78 cases harboring malarial parasites were admitted to the Hospital, with 5,553 laborers reported for the week); in 1927, it reached 1% (82 cases, with 8,126 laborers); in 1928, 0.40% (31 cases, with 7,712 laborers); and in 1929, 0.18% (12 cases, with 6,312 laborers).

This peak can only be explained on the basis of the labor migration. Study of the rainfall, which is greatest during May, October, and November, and least in February and March, fails to give an adequate explanation. When this is

correlated with an analysis of the daily reports on *Anopheles* breeding, it is evident that mosquito bionomics is not the cause.

On the other hand, the crop season began on the first of January during these four years. During December, the cane-cutting labor begins to enter the Division and is distributed in a number of camps (about 80) throughout the farm area. This labor was well infected with malaria before entering the Division; as shown by two blood surveys made in 1927 and 1928, which gave approximately 25% positives.

CURVE OF MALARIA CASE PERCENTAGE OF LABOR POPULATION ADMITTED TO PRESTON HOSPITAL

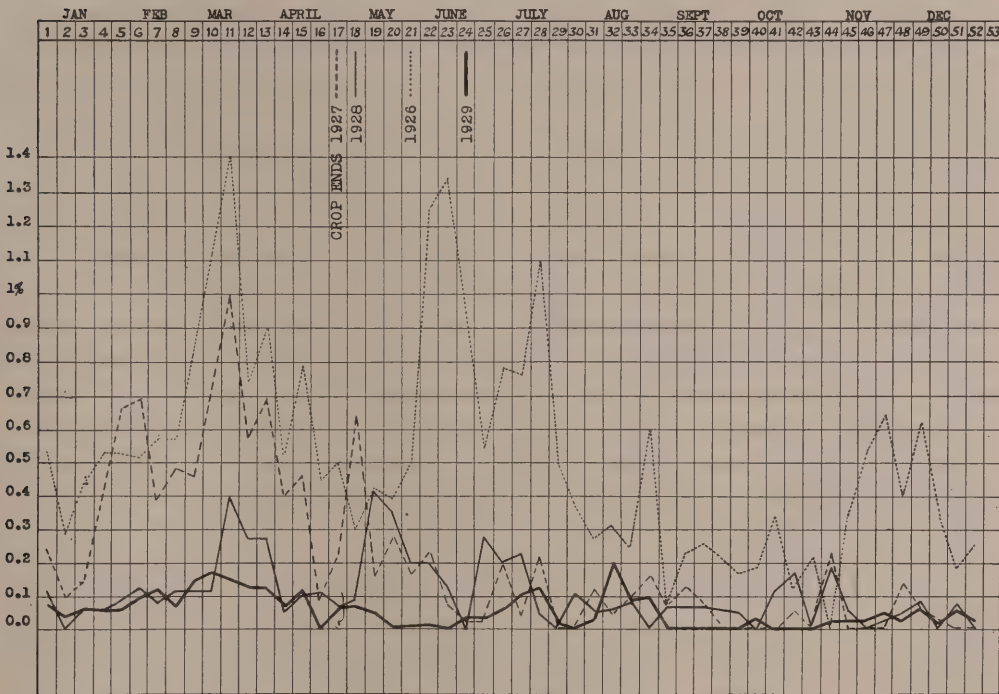


CHART 1

These individuals live in most intimate contact in their camps; and, taking into consideration the high percentage of infected individuals already present in the group when they first came in and the abundance of *Anopheles albimanus* (the principal malaria vector of this region), together with the arduous labor to which the laborers are subjected, it is easy to understand that more and more individuals become infected as weeks go by until in the third week in March the largest possible number have acquired the disease.

It is not known what the curve would show if no treatment were given and no mosquito control were attempted; but, under control conditions, the number of cases rapidly diminish, and they continue to diminish until the end of the crop.



This may be partly attributed to an acquired tolerance to the infection as the result of which the people, although harboring parasites, develop no clinical symptoms sufficiently acute to require medical attention; and partly to the administration of quinine and plasmochin on a large scale.

At the termination of the crop, a large number of the immigrant cane-cutters return to their homes; and one week following this exodus there occurred the second peak. This peak was clear-cut in the years 1926, 1927, and 1928; while in 1929 no peak occurred until the third week following crop, and it was hardly noticeable.

This second peak is also explainable on the basis of the labor migration. Although the labor census drops considerably, the number of infected cases entering the Hospital does not diminish proportionately; and hence a rise in the rate occurs. Many people who are due to leave the Division at the end of the crop but who have minor ailments, request admission to the Hospital at this time; and, on routine blood examination, are found to harbor parasites.

This second peak reached 1.35% in 1926 (21 cases, with 1,550 laborers reported); 0.66% in 1927 (10 cases, with 1,514 laborers reported); 0.42% in 1928 (7 cases, with 1,632 laborers reported); and 0.11% in 1929 (4 cases, with 3,393 laborers reported). During 1926 other rises occurred—e.g., in August and in November-December, but these were eliminated in the following years.

It will be interesting to continue this curve each year, to observe what further reduction results.

It is quite obvious that the object of the campaign is to flatten this curve as close to a straight line at "O" as possible. That this flattening process has been relatively successful to date, seems quite evident from a study of the curve and of the total percentages which show:

Year	Average Weekly Labor Census		Average Weekly Malaria Admissions		Average Morbidity Rate per Week	
	Crop Season	Dead Season	Crop Season	Dead Season	Crop Season	Dead Season
1926	5,930	2,042	35.90	8.83	0.607%	0.434%
1927	7,627	1,854	35.70	1.80	0.468%	0.097%
1928	7,335	2,228	9.66	2.11	0.131%	0.094%
1929	7,397	3,819	6.60	1.60	0.078%	0.049%

## CONTROL OF MALARIA IN COSTA RICA

E. I. SALISBURY, M.D., F.A.C.S., and J. A. CORRIGAN

The republic of Costa Rica is located in the Torrid Zone, and is traversed by the Cordilleras running from northwest to southeast which are broken in the central part by a broad plateau.

The population is mainly concentrated in the high plateau; in the cities of Puntarenas on the Pacific side and Port Limon on the Caribbean side; and in

towns along the railway connecting these terminal cities, as well as in villages located on the tram lines which connect with the main line and its branches.

Costa Rica is a white man's republic. Eighty per cent of the population are pure Caucasian (mainly of Spanish descent); while the remainder are native Indians or West Indian negroes.

TABLE I  
TERRAIN OF CONTROLLED AREA—MILES AND ELEVATION

	Miles	Elevation	Distance Between	Difference in elevation	Ft. Raise per Mile
Limón. . . . .	0.00	6'	0.00	0.00	0.00
Zent. . . . .	19.9	62'	19.9	56.00	2.8
Estrada . . . . .	21.9	39'	2.0	23.0	11.0
Matina . . . . .	23.4	37'	1.5	2.0	1.3
Good Hope. . . . .	25.0	48'	1.6	11.0	6.9
Waldeck. . . . .	27.8	82'	2.8	34.0	12.15
Monte Verde. . . . .	32.0	130'	4.2	48.0	11.19
Siquirres. . . . .	37.1	300'	5.1	170.0	33.3
La Junta. . . . .	39.0	300'	1.9	0.00	0.00
Las Lomas. . . . .	46.1	5.84	7.1	284.0	40.0
Pascua. . . . .	49.6	820'	3.5	236.0'	67.4
Bonilla. . . . .	51.0	824'	1.4	4.0'	.3
Peralta . . . . .	55.0	1,150'	4.0	326.0'	81.5
Turrialba . . . . .	63.0	2,050'	8.0	900.0'	112.5
Pejivalle Br. . . . .	72.0	2,200'	9.0	150.0'	16.6
Zapote Br. . . . .	75.0	2,500'	3.0	300.0'	100.0
CASTRO BRANCH					
Limón. . . . .	0.00	6'	0.0	0.00	0.00
Zent. . . . .	19.9	62.0	19.9	58.0	3.1
SWAMPMOUTH					
Limón. . . . .	0.00	6.0'	0.00	0.00	0.00
Estrada . . . . .	21.9	39.0'	21.9	23.0	1.5
MONTE VERDE BRANCH					
Monte Verde. . . . .	32.0	130.0'	0.00	0.00	0.00
Pacuare . . . . .	49.0	118.0'	15.0	115.0	7.67
GUAPILES BRANCH					
La Junta. . . . .	39.0	300.0	0.00	0.00	0.00
Guápiles. . . . .	59.5	886	20.5	586.0	29.3
ESTRELLA BRANCH					
Limón. . . . .	0.00	6'	0.00	0.00	0.00
Ley River . . . . .	31.6	30.0	31.6	30.0	.95

Table I gives the elevations and distances between stations along the main lines of the Railroad and in the area where malaria control work is at present being done.

#### PHYSICAL TOPOGRAPHY—HIGHLAND AREA

Natural conditions, in the area of the Costa Rica Division in which control measures are operating, have features favorable for anopheline production which

are not similar to those in any of our other divisions. These will be referred to later in greater detail.

As shown by Table I, using Port Limon as a starting point and ascending to Zapote Camp, Pejivalle Farm, 75 miles inland, one goes from sea-level to an altitude of 2,500 ft. In an anopheline survey and inspection in 1926, by one of the co-authors of this paper, it was shown that the albimanus was then, as it is now, the predominating species.

The region from La Junta, Mile 39 (elevation 300 ft.), to Peralta, Mile 55 (elevation 1,150 ft.), is situated in the Reventazon gorge, which has been formed by the Reventazon River, and is drained by it and, in the wet season, by its tributaries from the mountain torrent. The variability in the floods of these streams gives headaches to our sanitarians and engineers.

#### SEASONAL CONDITIONS—HIGHLANDS

Streams which become torrents in the wet season change their courses several times during this flood period. When the heavy rains cease, the water subsides and recedes to the main channel of the stream; and hence in the dry season many of the river beds, which were raging torrents in the wet season, become merely a series of unconnected pools. These pools are fed by seepage water from the river. Algae and wild water cress develop in them, and the intense heat from the rays of a tropical sun on the water (which is retained in rocks and boulders and gradually dissipated well into the night) make these pools ideal breeding places for *A. albimanus*; and the normal egg-to-adult period is thus considerably reduced.

The Tigre and Pejivalle rivers (elevation 2,500 feet and upwards) run through gorges somewhat similar to the Reventazon; and at this altitude *A. albimanus* are plentiful in the dry season, and concentrate where conditions for breeding are most favorable.

#### LOWLAND BREEDING

From Limon (elevation 6 ft.) to Ley River, a distance of 31.6 miles, is a flat stretch of coastal territory; and of similar character are the areas from Limon to Monte Verde—a distance of 32 miles, and the coastal region from Monte Verde to Pacuare—a distance of 15 miles. In these coastal plain areas of low elevation, between town sites, villages and banana farms, are pastures with short grass. The top soil is of impervious clay, in which the grazing cattle leave hoof prints. These artificial conditions which also include man-made depressions around houses, ditches, holes, etc., and the swampy areas in the lowland and adjoining rivers and creeks, are the chief sources of mosquito production during the wet season when it is not at all unusual for the lowlands to be inundated.

We are of the opinion that, in this country at least, altitude up to 2,500 feet has little or no bearing on the degree of breeding of the anopheline mosquitoes, other conditions being favorable.

During the dry season, due to lack of water in the usual breeding places, the



locations of breeding, which are spread over large areas in the wet season, are reduced to more concentrated areas with more intensive breeding.

### RAINFALL—HUMIDITY—TEMPERATURE

The average rainfall, humidity, and temperature for the past few years is given below:

Rainfall (Inches)								
Siquirres	Zent	Turrialba	Banana River	Limon	Costa Rica Division			
154.72	126.38	105.60	127.42	133.28	129.90			
Humidity								
Siquirres		Turrialba		Bananito		Costa Rica Division		
Average . . . . .		83		82		82		
Temperature								
Max.		Min.		Max.		Min.		
Average . . . . .		93°		58°		92°		
						61°		
						94°		
						52°		

### PRESENT ORGANIZATION

The sanitary force consists of one Division Sanitary Inspector with motor transportation, and a total labor force of 43 man-days per week. This force, in addition to dusting the controlled area of the 40 major farms together with villages and railroad camps, also collect and mixes Paris green dust, at a cost of \$50 per week for labor. About 20 pounds of Paris green is used per week at a cost of \$5. This brings the total cost of labor and material to \$55 per week. This sum does not include motor car operation costs.

We require that the Division be covered at least once in every ten days, and preferably every eight days.

### POPULATION

Employees . . . . .	5,000
Non-employees . . . . .	7,000
Others in the Banana Zone benefiting from our work and mainly dependent on the United Fruit Company for a living and medical service . . . . .	23,000
Total. . . . .	35,000

### METHOD OF CONTROL

The Division Sanitary Inspector reports direct to the Medical Superintendent. Aside from malaria control the Sanitary Inspector is responsible for general sanitation in the Division, as well as the inspection of houses for screen repairs. He also supervises the making of the larvicides. Paris green is mixed by hand in a rotary mixer fitted with baffles. One part of Paris green is mixed with 100 parts of fine river silt, which is the most available diluent and the easiest to collect.

The Sanitary Inspector ships the mixture to strategic points in the division from where he can easily obtain it when wanted. He also carries a few tins on the motor car. When applying, the mixture is carried in light canvas bags with

shoulder straps and applied by hand or dust gun, using the wind as a conveyor. Furthermore, when the motor car is traveling along the railroad, dust is applied by a mechanical blower attached to the rear of the car on either side and this takes care of the borrow-pits and railroad ditches. Along tram lines the gauge is too narrow for the motor cars to go, and the dust is applied from the mule-hauled tram car. On these side lines the overseer of each farm is responsible for weekly applications of dust, subject to the inspection of the Division Sanitary Inspector.

The Sub-Sanitary Inspector covers his area on a track bicycle and takes along one laborer who is a combination helper and duster. The Sub-Sanitary Inspector reports to the Division Sanitary Inspector.

Places requiring drainage are called to the attention of the Chief Engineer and one of his engineers versed in drainage accompanies the Medical Superintendent and Division Sanitary Inspector on inspection tours and determines the proper and least expensive methods of accomplishing the work. We do not believe in delegating this work to any other than a competent drainage engineer. As the work progresses checks are made by the engineer to see that his recommendations are properly followed. Where excavated material is piled at the sides of drains, openings are cut through at low points and water that might be impounded by the dam thus formed is drained. Ditches should run at an angle to the stream which it enters, and not at right angles or against the water in the main stream. This reduces the number of cleanings required, and does not permit deposits of silt at the junction.

The costs of a general drainage scheme for malaria control in this division would be prohibitive, due to the peculiar nature of the terrain, natural and artificial. In many localities we therefore rely on our weekly Paris green applications in lieu of permanent drainage.

Aside from the antilarval work, we use insecticide sprays in camps and cars where the adult anopheline index is high, in order to reduce the number of mosquitoes which may be infected. We also inspect quarters for sick, giving them immediate treatment and reporting them to the dispenser who follows up the treatment.

Our present knowledge of malaria and its control permits us to limit our objective to the vector and the carrier. This perhaps is a simple statement, but the accomplishment of anything near a perfect control is not as easy as the pronouncement—yet it is not discouraging in its results if the problem is thoroughly studied, the attack planned, organization effected, and the work checked from both objectives. Persistence in control efforts is essential.

With the above mentioned methods known, it is only necessary to apply them in a manner and at a time that will prove most effective. Knowledge of the terrain, rainfall, prevailing winds, the population, the larval and mosquito index, and the malaria index as well, are necessary to control this disease effectively, in a practicable manner, and with the least expense.

Control work as it is practised in the United Fruit Company properties has been developed from the standpoint of economy and effectiveness.

Antimalaria work and sanitation was begun in this Division in the fall of 1926, but without striking results. Men had to be trained in this new work and from experience we also learned much. Real control work was not well under way until the middle of the year 1928. Although many unexpected problems have come up that have temporarily increased malaria rates, yet the tendency is downward and the outcome is encouraging.

#### GENERAL OUTLINE OF PROCEDURE

In this Division the cultivated areas are divided into districts. This is desirable in any campaign, so that similarly situated districts as well as those of dissimilar environs and topography can be properly compared for statistical purposes. This is of scientific value as well as of psychological worth when it comes to spurring to more active work those whose district is below the standard set by the neighboring district. A general survey is made to determine the extent of breeding areas, their nature, location and the like so as to determine the type of treatment most likely to be practicable and effective. Next, a house-to-house survey for adult anopheline mosquitoes is carried out. Finally, a thick-film blood examination is made of all men, women, and children—to determine the disease incidence. Antilarval work is immediately instituted and adult mosquitoes are killed in houses by insecticide sprays. When the index of malaria infection is high, every person in the district or town is given at least four days' treatment of plasmochin compound tablets supplemented by additional quinine. It is much safer and wiser to treat every one rather than just the positives, for those familiar with the work of examining blood specimens daily know that a smear negative today may be positive tomorrow.

The antilarval work is kept up continuously so that each locality is visited every week or ten days. This work is confined to short-radius work except where experience has taught that further removed and concentrated areas of breeding are a menace.

Experience has also shown us that in this Division two general blood surveys per year, together with the Hospital admissions, are sufficient to give us a very accurate picture of the malaria index. One of these surveys is made in March at the end of the so-called dry season and the other in August at the end of the long wet season. Throughout the year 4 dispensers are busy in general work. Three of these, in traveling dispensary cars, complete their rounds once every two weeks; and endeavor to give everyone at least one dose of quinine and plasmochin compound on each visit. The other dispenser is located in a large district and, besides his general work, systematically dispenses quinine and plasmochin to all the inhabitants about three times in the year. One other dispenser works at large in remote farms giving antimalarial treatment. Overseers and track foremen are entrusted with plasmochin and quinine and urged to treat all new-



comers and their families as possible "carriers" with these remedies for at least four days.

This summarizes briefly how the problem is handled in this Division.

#### EDUCATION

We are dealing with a working class that for the most part are uneducated. Some are superstitious, many have fixed ideas as to the cause and treatment of fever, and malaria control methods have to almost be forced upon them. Still, by contact with the physicians, dispensers, overseers, sanitary men, and the use of placards, they are gradually sensing the benefits of our work. In time, no doubt, and particularly with the growing generation who are taught the fundamental facts about malaria in the schools, there will develop an intelligent understanding of the first rules of sanitation in general and the prevention and treatment of malaria in particular.

#### THE COST OF PREVENTION AND TREATMENT

The United Fruit Company maintains a Hospital in each of their tropical Divisions. These Hospitals are operated primarily for employees and their families; but they are generally the only modern hospital service available for others in the locality. In this Division in 1929, medical treatment including hospitalization, antimalaria prophylaxis and sanitation cost \$0.06 per employee per day; and of this \$0.05 went to hospitalization, and \$0.01 to sanitation and antimalaria work.

During the two years of our intensive antimalaria work, 719,000 five-grain tablets of quinine have been dispensed together with 325,000 doses of plasmochin compound tablets and 560,000 Pink Tonic Tablets as follow-up treatment, all at a cost of \$4,800 per year.

This expense of course will be less as malaria loses its place as our greatest economic disease and problem.

#### RESULTS OF THE CAMPAIGN

We refer you to the following data:

##### *Admission Rate for Employees to the Hospital per Thousand Employees*

1929	1928	1927	1926
398	504	596	587

##### *Admission Rate of Employees with Malaria to Hospital per Thousand Employees (Primary and Secondary Diagnoses)*

1929	1928	1927	1926
111	170	230	269

##### *The Death Rate of Employees Admitted to the Hospital for Malaria per Thousand Employees*

1929	1928	1927	1926
0.79	0.9	3.2	3.3

The total death rate among employees of this Division, including Hospital deaths, those treated in dispensaries, those not treated by our department and sudden deaths, was 14.03 per thousand.

The average death rate of the Republic of Costa Rica for the 20-year period, 1906 to 1925, was 24 per thousand; while that of the coastal area, where most of our laborers are employed, was 30.5 per thousand.

The results of our labors are reflected not only in the reduction of malaria as shown but also in the reduction of the number of employees admitted to the Hospital for other causes. This reduction amounted to 106 per thousand employees in 1929 over 1928, and 92 per thousand in 1928 over 1927.

To show that both the field and hospital rate has declined, I call attention to the table shown below which gives the results of malaria surveys during the past four years and the corresponding hospital rates for malaria.

TABLE II

	Malaria Field Survey Rates				Hospital Rates Employees with Malaria in Hospital	
	Bloods Examined	Positives for Malaria	Percentage Positives	Examiner	Cases	Rate per 1,000
1926	606	179	29.5	Dr. Clark	1,761	269
1927	679	258	39.9	Dr. Clark	1,483	230
1928	752	143	19.0	Dr. Clark	1,087	170
1929	1,879	231	12.3	Juan Coto	698	111

The results of our campaign in 1929 might have been more striking, had we not been hampered by the concentration of labor in isolated places at or near the slides and washouts on the railway. Camp sites, more or less inaccessible, sprang up over night and shifted as the work went on. Without a large sanitary force, in the face of interrupted transportation it was difficult to cope satisfactorily with such a situation. New labor came in from Guanacaste on the Pacific coast, and from private plantations to work on the railroad in the emergency and in some instances were subsequently employed on our farms. A fair control of mosquito breeding in the farm areas prevented the development of large incidence of malaria among the employees. While malaria was reasonably well controlled by our dispensers in the slide area; the results were not satisfactory until Mr. Corrigan visited the Division about mid-year and pointed out unsuspected breeding areas, which were immediately placed under control. About 185 cases of malaria were admitted to the Hospital from this area. Some idea of the labor involved in caring for the people in this district may be gleaned from the fact that quinine and other medical supplies had to be transported on the backs of men for miles overland, part of the way over mountains; some were shipped via the Panama Canal to the Pacific coast, and from there transported across; and some were sent by aeroplane. These difficulties were met and dispensary service rendered to the labor gangs along the whole line. Hospital cars were made of passenger coaches by replacing the seats by bunks, and all kinds of cases of illness and injury were successfully treated in the isolated camps.

## COMMENTS AND FURTHER EXPLANATIONS

In the course of a long campaign, work usually becomes a routine affair; and one is apt to become self-satisfied—particularly if things seem to be going well.

It is well to state, that sanitation can not be conducted from an office and, to quote LePrince, "The Sanitarian's enthusiasm should outlast his boots." The sanitarian should have good boots and use them, and travel a bit afield away from the beaten track and beyond the usual range of vision, around camps and town-sites. We have had experiences recently, that has taught us to anticipate trouble perhaps when things are going well. Three different outbreaks of malaria registered recently on our indicator. We keep two weekly records—one of all admissions by districts and labor camps, and the other of admissions for malaria separated in the same manner. By these records or indicators we learn at once of any unusual trouble.

The Limon district began sending in malaria patients to the Hospital and dispensary. Notwithstanding reports of our divisional inspector that nothing was amiss, we made an inspection trip covering all the usual breeding areas without finding larvae until we noticed that the sea had formed a sand bar at the mouth of a brackish lagoon (Cienaguita). In several previous surveys no breeding had ever been found in this lagoon and we had come to look upon it as harmless. A caprice of the sea had changed this condition; and the water became fresher from the creeks and rivers flowing into it, and the now stagnant fresh-water lagoon was actually teeming with larvae. In two days the problem was solved. It was found more economical to use Paris green dust than to cut through 500 feet of sand bar and establish drainage. With a few men walking along the swamp edges and using one boat, a total length of three miles was dusted. We were thus successful in preventing a probable epidemic of malaria in the town of Limon and its suburbs. We had just completed a survey on the other side of the village across the lagoon from Limon (always difficult to control) and found only 6% infection. An immediate survey was again made of this threatened area. It showed 20% positives, which would have probably doubled in another fortnight. Larval control and specific treatment of all the population in this location stamped out this focus of infection.

Another highly infected locality originated from breeding in the Reventazon river bed over a distance of several miles. During the extremely dry weather the river had so diminished in volume as to leave pockets in the rock and sand bars favorable to the growth of algae and consequent breeding.

The third flare up of malaria came from the west side of the city of Limon, and in homes along a slope that is usually considered fairly free from malaria. The source proved to be in new open concrete sedimentation tanks of the city water supply. Due to shortage of water, the tanks did not receive their weekly cleaning. Algae formed; and larvae were present to the extent of 150 to the dip. This focus of breeding was easily controlled.



Increased efforts during the dry months when breeding is concentrated and easily controllable will lessen propagation during the wet season and thus greatly reduce the chance of infection and the seasonal rise of the malaria rate. We are now in a position in this Division to prove this hypothesis. Pastures are now dry and breeding is taking place chiefly in the large rivers. If the first rains are light and steady, breeding will be transferred to pastures and swamp land. If the rains are heavy with freshets in the rivers, nature will sanitize for us and wash the seed beds of larvae out to sea.

The relation of the rainfall to the malaria rates is very interesting. While the heaviest rainfall occurs usually in November, December and January, the malaria rate is low during those months—that is, lower than during the remainder of the year. Any study of this kind necessitates a knowledge of the country and its conditions and we believe that in the following remarks our interpretation holds true. Our seasons here are not sharply defined, but we have three distinct seasons. From year to year they may shift a month one way or the other, but in a general way November, December and January are our heavy rain months—flood months—and the larvae are washed away and adult mosquitoes are beaten down by wind and rain. During this time the malaria rate drops. This season is followed by a short dry season; and though it is short, the rivers expend themselves quickly and it becomes very dry. Breeding is concentrated and naturally near blood supply—camps, villages, etc.,—and infections begin to occur and the malaria rate starts its upward climb. (This is the time to strike with augmented force to kill off the seed beds by destroying larvae and treating the malaria carrier.) Then follows gentle, steady, daily rains soaking the ground, making pastures knee deep with water, and permitting water to stand in ditches. The rivers flow steadily but do not flood. Breeding spreads out from the seed beds and becomes general. The malaria rate steadily rises to its peak. Then the slow steady rains change suddenly to heavy flood rains; and nature once more becomes sanitarian, and the sea claims the larvae again and malaria drops.

Each year we feel that we have a better understanding of the problem and modify our methods of attack to meet existing conditions; and steadily the malaria rate decreases. At some point we believe that we shall find an index which, when reached in a given locality, will solve its malaria problems; just as yellow fever has its *Stegomyia* index which, when reached, results in the disease dying out. We are anxiously awaiting the day when the survey rate of anopheline mosquito and malaria parasite reach the point where we will be able to say of them that "*East is East and West is West and never the twain shall meet.*"

## PROGRESS IN MALARIA CONTROL\*

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Any program, which has as its object the effective control of malaria, must include a consideration of the rôle played by the causal parasite in the two hosts—the anopheles mosquito and man.

In the former the sexual phase takes place; and a mosquito once infected continues infective to human beings on each successive feeding probably as long as she lives.

Colonel S. P. James and P. G. Shute<sup>1</sup> report that they kept an infected mosquito (*A. maculipennis*) alive for 92 days and during that period it had opportunities of feeding upon patients and therefore of injecting sporozoites into them on at least 40 occasions. It successfully infected a patient by a single bite more than two and a half months after it first became infective.

Unquestionably some species of anopheles live longer than 3 months, hibernate during cold weather and continue infective when warm weather returns.

Some mosquitoes, even of the same species, are more susceptible to malaria infection than others—Why? We do not know.

In man the parasites multiply asexually by sporulation, producing spores (merozoites) which are liberated in the blood stream. The merozoites which escape phagocytosis enter other blood cells. Some of them continue to multiply asexually, while others develop into sexual forms (gametocytes)—male and female.

The relative numbers of merozoites which develop into asexual and sexual forms respectively are unknown, but probably vary in different seasons, at different stages of infection and during varying physical conditions of the host.

Only those gametocytes which are withdrawn into a mosquito's stomach ever complete the life cycle for which Nature designed them—the perpetuation of the species in developing sporozoites to transmit the infection to other human hosts through the medium of mosquitoes.

By far the largest number of gametocytes developed in the human blood—and they are millions—live for a brief period, die, and are phagocyted like all other dead cells in the body.

Not all human carriers develop gametocytes which can transmit infection to mosquitoes. During some recent investigations in Honduras, Colonel Eugene R. Whitmore found 11 human “carriers” with large numbers of gametocytes in the blood. Batches of mosquitoes were repeatedly fed on all of them. With 3, not a

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single mosquito developed an oocyst, and with the other 8 all mosquitoes became richly infected.

These data show that some individuals only, among mosquitoes as well as among men, are responsible for malaria transmission; and their identification is possible only by tedious biological methods.

In order, therefore, to effect malaria control we are compelled to wage warfare against all anopheles mosquitoes within flight distance of habitations, and endeavor to cure all human carriers.

To prevent mosquito-breeding entirely over large areas is obviously impossible; and measures to that end must be restricted to short-radius sanitation about habitations, with the object of diminishing their numbers and thereby lowering the incidence of possible infection. A recent instance may be cited in illustration of the value of short-radius sanitation. A construction camp was reporting many cases of malaria, although the sanitary conditions in and about the camp itself were excellent.

A sanitary survey was made and prolific breeding found in pools in the river-bed adjacent to the camp. The river had been high and as it receded a number of pools in rock holes had been left. Their treatment with Paris green almost immediately caused a cessation of the fever cases.

Other similar instances have been observed. Apparently repeated infections will cause renewed febrile attacks when a chronic or latent infection can be tolerated without causing acute fever. In every malarious country localities exist where mosquito-breeding cannot be effectively controlled without unjustifiable expenditures. Under such conditions effectively screened houses offer the only economical solution. Screens are effective only if the occupants maintain them and seek their protection during the hours of the mosquito flight, and that means education.

Of equal or greater importance than the prevention of mosquito-breeding in the control of malaria are the measures directed to the treatment and cure of the human carrier.

As has been previously stated, some individuals are more susceptible to malaria infection than others, and this statement is applicable to races also. The negroes as a race are less susceptible and possess a higher tolerance to the disease than other races. Many individuals, however, from races other than negro possess a high tolerance or develop it from prolonged or repeated infection.

Experiences with the treatment of cases of *general paralysis* by infecting them with malaria have demonstrated that incipient infections are more readily curable than chronic infections. With incipient cases a few days treatment with moderate doses of the salts of quinine effects cures. A chronic infection, however, may exist for years. A kind of equilibrium is established between the parasites and the defensive agents of the body, and the victims may be at work and appear practically well and free from fever and parasites in the peripheral blood until the resistance of the natural defenses of the body is



lowered by some depressing influence, such as exposure to wet, cold, fatigue, etc., an injury, operation, acute infection, etc., when the parasites gain the upper hand. Sporulation *en masse* is then resumed; parasites appear in the peripheral blood; chills and fever recur; in other words, there is a frank relapse.

Under such conditions, rest in bed, free purgation and a good diet will, in many cases, without specific medication, restore the passive tolerance.

The only specific remedies known that will destroy the schizonts and prevent the further development of gametocytes are the salts of quinine, the administration of which must be in large doses (30 to 45 grains) daily during the acute attack and subsequently in smaller doses (10 to 15 grains) daily for an indefinite period.

Quinine apparently has a selective action in destroying the asexual parasites, but in what way is not known.

Warrington Yorke<sup>2</sup> makes the following statement:

There is now quite definite evidence that quinine in concentrations considerably greater than can ever occur in the blood-stream does not *in vitro* destroy all the malaria parasites. Muhlen and Kirschbaum (1924) found that a mixture of equal parts of defibrinated simple tertian blood and of a 1:5,000 solution of quinine was still infective after incubation for twelve hours at 37°C., and that if the strength of the quinine solution were doubled infection was still possible after five hours. In still unpublished experiments, Macfie and I have confirmed the observations of Muhlen and Kirschbaum that a mixture of equal parts of simple tertian blood and of a 1:5,000 quinine solution is infective after incubation at 37°C. for two and a half hours.

These experiments indicate that quinine alone is not responsible for the disappearance of the parasites from the peripheral blood, but quinine plus something in the living tissues—cellular, humoral or both—in other words, natural defensive agents.

It has been stated that the salts of quinine are effective in destroying the asexual forms, and hence in preventing development of the sexual forms. They do not, however, destroy the sexual forms of the estivo-autumnal parasite (crescents), but European observers believe they have a destructive action on the sexual forms of the benign types of malaria.

Dr. H. C. Clark, (observations confirmed by others) working in the plantations of the United Fruit Company found that, in acute attacks of malaria, more crescents were present in the peripheral blood 3 or 4 days after intensive treatment with quinine than before treatment was administered, and that after a week's intensive treatment in the hospitals, a far greater percentage of patients were carrying crescents than he found in untreated infected cases in his field surveys.

Apparently quinine creates an unfavorable environment conducive to the development of the sexual forms like other forms of unicellular life which under favorable conditions of growth multiply asexually, but under unfavorable conditions resort to spore or resting stages.

## PLASMOCHIN

In the recently developed product Plasmochin, (a synthetic preparation built up about one of the radicles of quinine) we have an effective agent against the gametocytes or sexual forms.

When plasmochin is administered in divided doses of from 4 to 6 centigrams daily, the peripheral blood is freed from gametocytes generally in from 3 to 6 days—rarely more. In many cases, however, in this dosage it proves toxic, producing nausea, gastric distress, vomiting, pallor of the skin, cyanosis, and even death with central liver necrosis. If there is prompt discontinuance of the drug when the first toxic symptoms appear, recovery of the patient takes place.

Dr. M. A. Barber and Mr. W. H. W. Komp, of the U. S. Public Health Service, found in a few cases among negroes that a single dose of 1 centigram of plasmochin prevented the development of oocysts in mosquitoes fed on the patients on successive days. Dr. Eugene R. Whitmore, pursuing this same line of investigation on natives in Honduras, found that after a single dose of 1 centigram of plasmochin no or only a few oocysts were found, but that after a single dose of 2 centigrams was given to patients with rich gametocyte infections batches of mosquitoes fed on them for 7 successive days in no case developed an oocyst.

Thus we have in plasmochin an effective agent for preventing mosquito infection in a dosage non-toxic to man, woman or child.

The drug has apparently little or no effect on the schizonts of subtertian malaria, but on those of the benign forms it probably has a curative value (Macphail)<sup>3</sup> particularly in the chronic-relapsing, quinine-resisting cases.

It must be emphasized that one of the essential requirements in the control of malaria is making available an adequate well-balanced food supply—necessary for the health and efficiency of labor.

It must also be emphasized that malaria is difficult to cure in patients suffering from complicating systemic or focal infections, malnutrition or organic degenerations, all of which need appropriate treatment.

## MALARIA-CONTROL PROGRAM

Bearing in mind the above data, a constructive program for the control of malaria in tropical regions, where it is endemic throughout the year, will consist of the following measures.

No program will prove productive of the best results unless the population is stabilized and not permitted to fluctuate between sanitary and insanitary districts without daily supervision.

No matter what his civil status, man is a social animal and seeks companionship irrespective of the distance he must travel. He desires a home and all that term conveys—wife, family, and a healthy environment where he can earn a living.

To meet these requirements in malaria-infected districts, wherever possible,

segregation in villages or camps is essential and married quarters must be provided—preferably with garden plots where essential foodstuffs can be grown.

In this manner home and social requirements are met, and from the standpoint of sanitation the areas requiring mosquito-breeding control are restricted to narrow limits.

The sites selected for villages and camps need serious consideration if continuous maintenance expenditures are to be reduced to a minimum. Easily drainable ground should be selected as far as possible from uncontrollable mosquito-breeding areas, and an abundant supply of water for drinking and other domestic uses made available. It is far more economical to provide wells or pipe water from a distance than to locate a village near a running stream or pond that does not admit of sanitary control without continuous and heavy expenditures.

The village should be planned in such a way as to make provision for the easy disposal of wastes—water, garbage, human excreta, etc.

Convenient locations should be selected for public buildings—school, dispensary, etc.; and shrubs and trees planted and the surroundings made attractive in order to inculcate feelings of civic pride.

*School.*—The school should include in its curriculum elementary studies on malaria, hygiene and nutrition thus disseminating knowledge of a character to make the inhabitants healthy, self-reliant and contented. In a short time instead of one sanitary officer in a district, all the inhabitants would function in that capacity.

*Dispensary.*—The duties of a dispenser or practicante should include not only the dispensing of drugs but also the daily inspection of homes and labor camps. He should be capable of treating simple ailments and injuries, and of identifying serious cases and sending them to the dispensary or hospital.

*Sanitary Officer.*—The duties of a sanitary officer should include the inspection and care of all potential mosquito-breeding water surfaces within short-radius distance of habitations; also the care of latrines, and the disposal of wastes—water, garbage, etc.

*Drugs.*—Fully realizing that the administration of quinine can be safely left in the hands of the intelligent layman to cure all but pernicious cases of malaria, now that plasmochin in small non-toxic doses is effective in preventing mosquito-infection, the control of malaria has become a home and lay problem instead of a hospital and skilled medical problem.

Intelligent medical supervision supplemented by a technician to check up progress reports and a cooperating organized lay personnel educated in some elementary essentials should be able to control malaria in any tropical district to the extent of its ceasing to be a serious economic problem.

In the plantations of the United Fruit Company this plan is being gradually developed and has been under way for over 3 years, but as yet is by no means 100% perfect in all Divisions. It has, however, resulted in a phenomenal fall in the number of cases requiring hospitalization, and also in a greatly lessened



incidence of malaria in the plantations, as determined by periodical thick-film surveys.

Table I shows the hospital admissions for malaria from 1925 to 1929 inclusive.

TABLE I  
*Hospital Admission Rate for Malaria (Primary Diagnosis Only)*  
Per Thousand Employees Per Annum

	1925	1926	1927	1928	1929
Chiriqui Land Co. . . . .	—	—	—	—	138
Colombia . . . . .	96	69	53	64	124
Costa Rica . . . . .	157	260	222	148	94
Guatemala . . . . .	325	301	209	135	101
Panama . . . . .	230	165	111	120	70
Tela Railroad Co. . . . .	183	158	200	113	120
Truxillo Railroad Co. . . . .	259	196	183	162	170
Banes . . . . .	519	459	131	54	31
Preston. . . . .	242	135	100	37	18
Total (incl. Chiriqui) . . . . .	239	215	147	100	93
Total (excl. Chiriqui) . . . . .	239	215	147	100	89

A very extensive malaria survey of the laboring population by Dr. H. C. Clark in 1925 and 1926 showed an incidence of 41%.

The surveys made during 1929 rarely show an incidence above 20%, and in 2 Divisions less than 10%.

There has also been a material increase in the earning capacity of all the stabilized laborers.

In the Preston Division, Cuba, the cane cut per man per diem in 1925 and 1926 averaged less than 1 ton per day; in 1927, about 1.23 tons; in 1928, 1.39 tons; and in 1929, 1.61 tons.

We are now encouraged to believe that malaria can be controlled to such an extent that it ceases to have the serious economic importance which previously prevailed.

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A PRELIMINARY REPORT ON SOME PARASITES IN THE BLOOD  
OF WILD MONKEYS OF PANAMA\*

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The recent works of Wenyon (1), Hegner (2) and others have collected the records concerning the parasites of monkeys in a very concise manner. A large part of these records refer to monkeys belonging to the eastern hemisphere, chiefly Africa and Borneo. Gonder and Gossler (3) in 1908 described *Plasmodium brasilianum* in a monkey (*Brachyurus calvus*) which had been imported to Hamburg from the Amazon district of South America. Seidelin (4) in 1912 described a parasite, probably a plasmodium, in a monkey (*Ateles sp.*) of Yucatan. These reports stimulated my interest in the parasites of monkeys. My field observations have been largely confined to a search for plasmodia in local species of monkeys that were not living in captivity. I found a quartan-like plasmodium in a wild monkey (5) (*Cebus capucinus capucinus*) that was captured in an uninhabited part of the Chagres river basin (Rio Boqueron) in February, 1917. The same monkey revealed a trypanosome of large size. No descriptive record was made of these parasites at that time and two subsequent trips to the same area failed to acquire any further evidence of these infections.

During the month of July, 1929, an opportunity presented itself to make a survey of some wild monkeys in an uninhabited region of Panama during the early part of the "rainy season." Our party interested itself in a number of problems but this report will be confined to a preliminary statement of the parasites of the blood stream.

## LOCATION OF THE SURVEY

Our camp was located at approximately 8° 24' 30" North Latitude and 82° 55' 00" West Longitude and at a point, in an air line, 7.5 miles from the Pacific coast. The elevation of the camp site was 75.5 feet and the area surveyed was more or less a flat coastal plain.

All of the monkeys captured were taken from July 11 to July 23 inclusive except for one specimen of white face monkey and four howling monkeys which were taken about a mile from the coast a day or two later. Table 1 will show the meteorological report from a pioneer station of the Chiriqui Land Company a half day's walk to the south of our camp.

## METHOD OF EXAMINATION

a. It was only possible to prepare ante mortem blood films from two monkeys, otherwise all investigations were post mortem. The post mortem period ranged from one to five hours, in most cases being about three hours.

\* Originally published in *The American Journal of Tropical Medicine*, Vol. X, No. 1, January, 1930.

b. A blood film (thin) was made in the usual manner and Wright's stain was used.

c. A thick blood film, using about five times the amount of blood contained in a thin film, was made and thoroughly dried in a circular patch about half an inch

TABLE 1  
METEOROLOGICAL RECORD

Date	Temperature			Relative Humidity				Rain inches	Time of Rain	Hours of Sunshine
	Maxi- mum	Mini- mum	Mean	7 a.m.	1 p.m.	5 p.m.	Mean			
July 11	88	71	79	97	88	94	93	0.28	4 p.m.	4.5
July 12	90	73	82	97	80	96	91	0.27	4 p.m.	1.5
July 13	91	70	81	97	83	88	89	0.10	9 p.m.	2.0
July 14	89	72	81	98	78	94	90	0.09	8 p.m.	1.7
July 15	89	70	80	99	63	85	82			5.5
July 16	91	72	82	99	72	79	83			
July 17	90	69	80	99	68	95	87	0.02	7 p.m.	5.3
July 18	91	71	81	99	73	97	90	0.27	5 p.m.	6.4
July 19	90	70	80.0	99	78	96	91.1	0.88	5 p.m.	6.1
July 20	90	68	79.0	97	65	82	81.3	0.17	5 p.m.	3.8
July 21	90	69	79.5	98	70	78	82.0	0.01	4 p.m.	6.4
July 22	90	71	80.5	99	72	90	87.0	0.05	8 p.m.	6.9
July 23	88	72	80.0	99	91	87	92.3	0.16	12 m.d.	0.0
July 24	88	72	80.0	100	74	74	82.7			4.3
July 25	89	72	80.5	100	80	85	88.3	0.01	5 p.m.	1.5

TABLE 2  
STAINED BLOOD AND TISSUE FILMS

Monkey Species	Number of exami- nations	Positive Malaria Parasites		Positive Malaria Pigment		Positive for Try- panosome		Positive for Micro Filaria	
		Number	Per Cent	Number	Per Cent	Number	Per cent	Number	Per Cent
<i>Ateles geoffroyi</i> (red spider monkey) . . . . .	24	7	29.1	15	62.5	0	0	22	91.6
<i>Cebus capucinus imitator</i> (Panama white- throated monkey) . . . . .	31	3	9.7	12	38.7	13	41.9	27	87.1
<i>Saimiri orstedii orstedii</i> (Titi monkey) . . . .	54	0	0	0	0	14	25.9	49	90.7
<i>Alouatta palliata inconsonans</i> * (Panama howling monkey). . . . .	4	0	0	0	0	4	100.0	0	0
Totals. . . . .	113	10	8.8	27	23.9	31	27.4	98	86.7

\* No deep tissue films examined.

in diameter. This film was laked and stained in an aqueous solution of Giemsa's stain for a period of one hour, using 1 cc. of the stock solution of Giemsa's stain to 30 cc. of water that had a reaction closely approximating that of freshly distilled water.



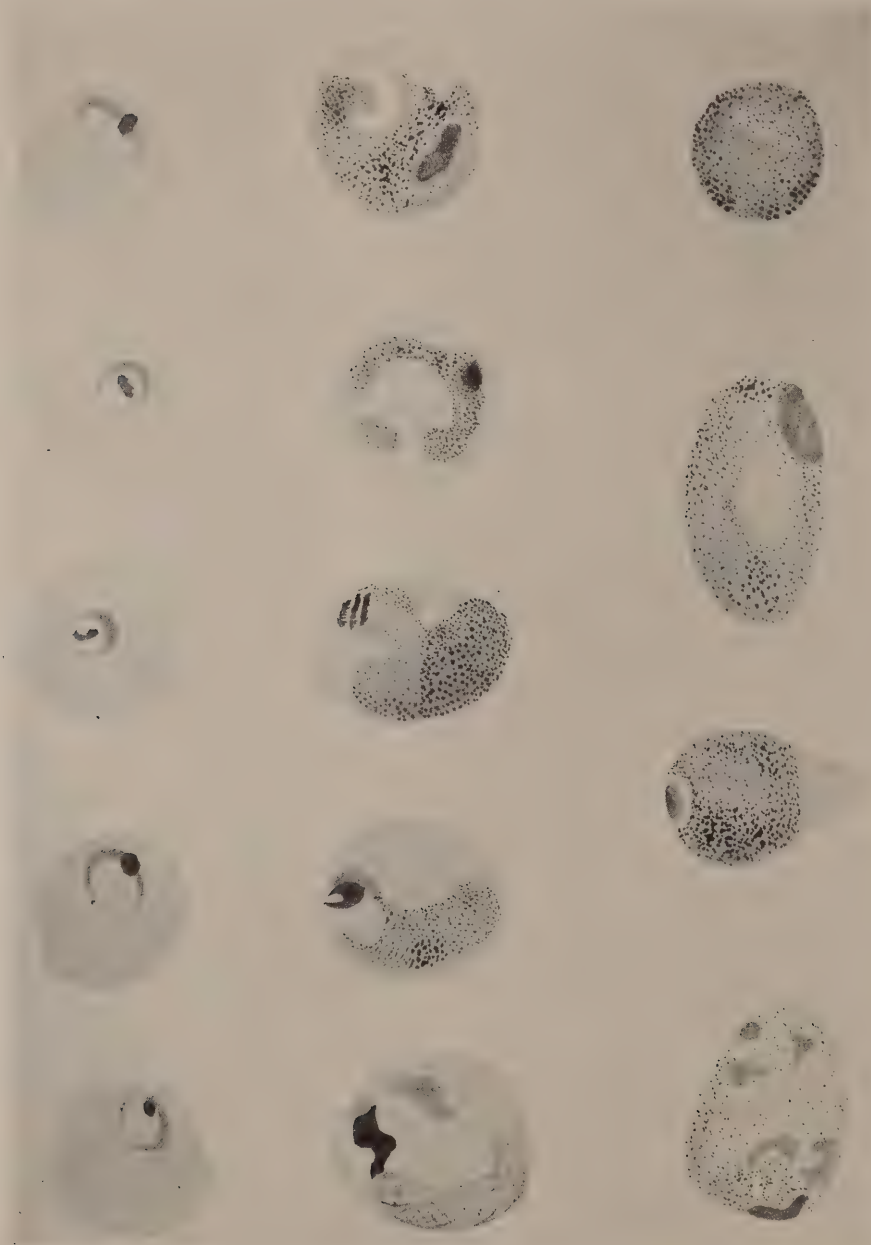


PLATE 1

PARASITES FOUND IN THE THIN BLOOD FILM FROM RED SPIDER MONKEY 27

Wright's stain was employed. The young and old trophozoites resemble *P. vivax* and three of the parasites in the lower row resemble tertian gametocytes.

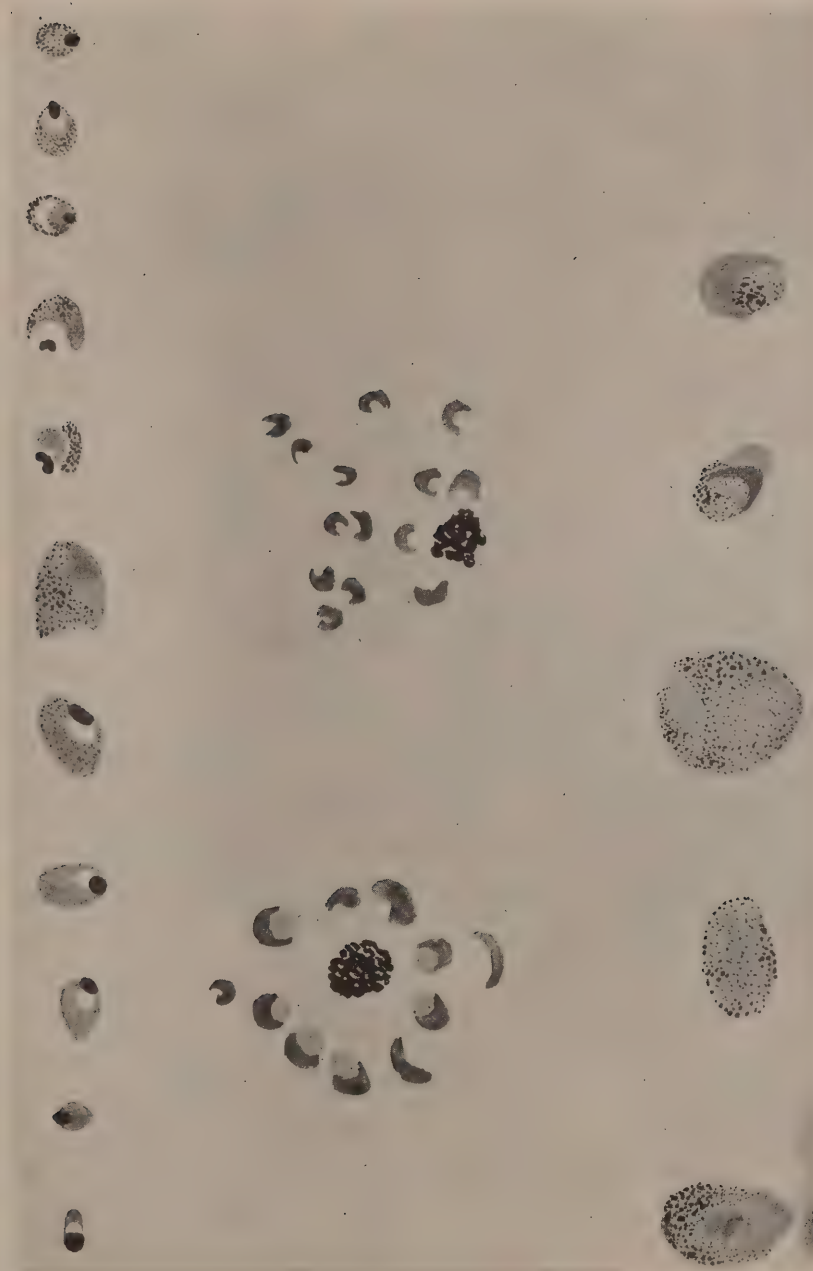


PLATE 2

A THICK BLOOD FILM FROM RED SPIDER MONKEY 27

An aqueous solution of Giemsa stain was applied for one hour. Note the difference in appearance of the young trophozoites in the thick film treated in this manner. The segmenting parasites divide into 10 to 14 merozoites. The lower row probably represent gametocytes.

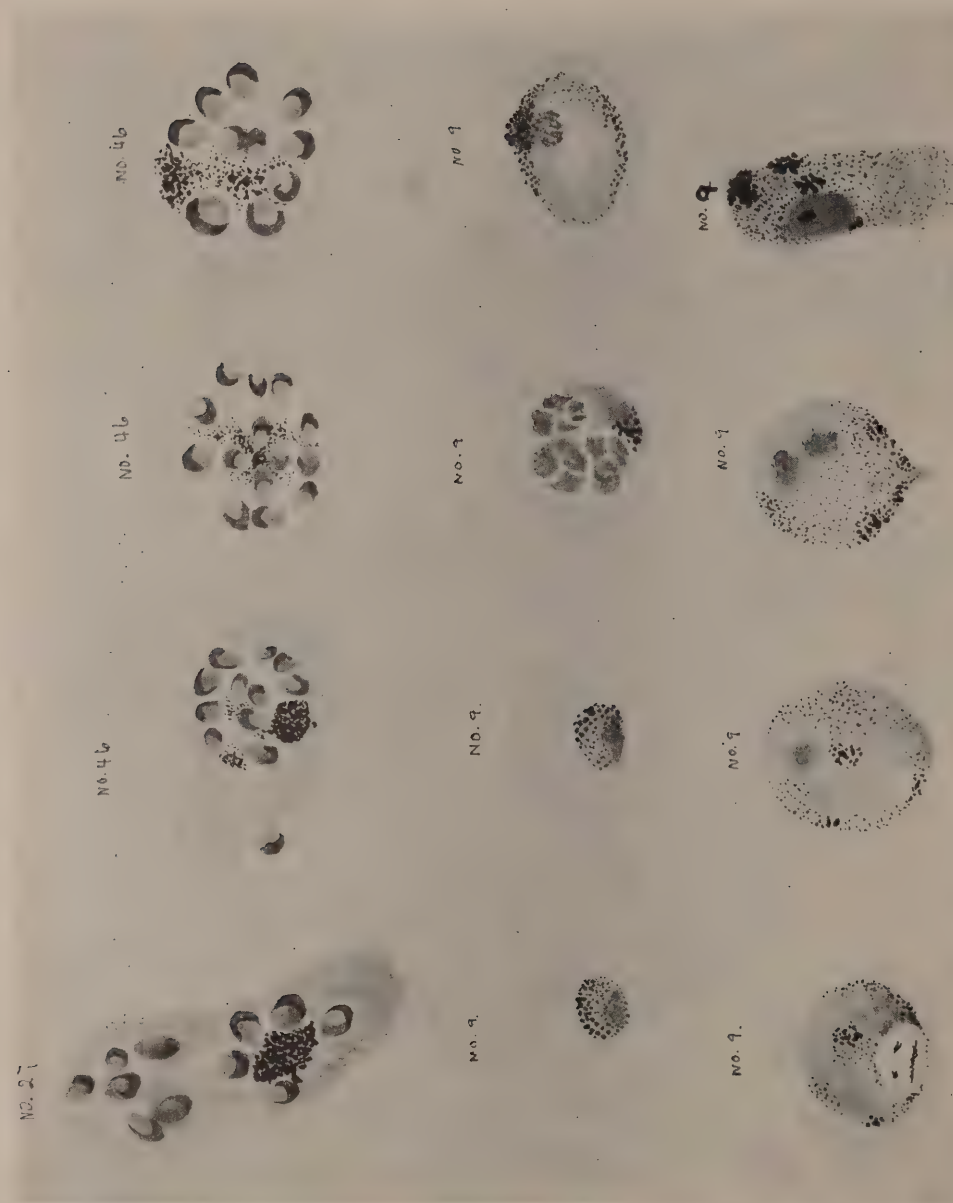


PLATE 3

This group of parasites were found in the spleen films from red spider monkeys 9 and 27. Wright's stain was employed. The top row shows enlarged red cells containing segmenting parasites dividing into 9 to 14 merocytes. The cell in the lower right corner represents a spleen cell loaded with pigment. The other parasites probably represent young and old gametocytes.



d. Crushed tissue films were made from the following organs: gray matter of the brain, rib marrow, spleen pulp and inguinal lymph node. These films were dried and stained in the same manner as the thin blood film.

e. Blood was aspirated from the heart of the monkeys and defibrinated. Subcutaneous inoculations were then made into guinea pigs, from the pooled blood of each day's collection of monkeys, and into a large female monkey (*Macacus*

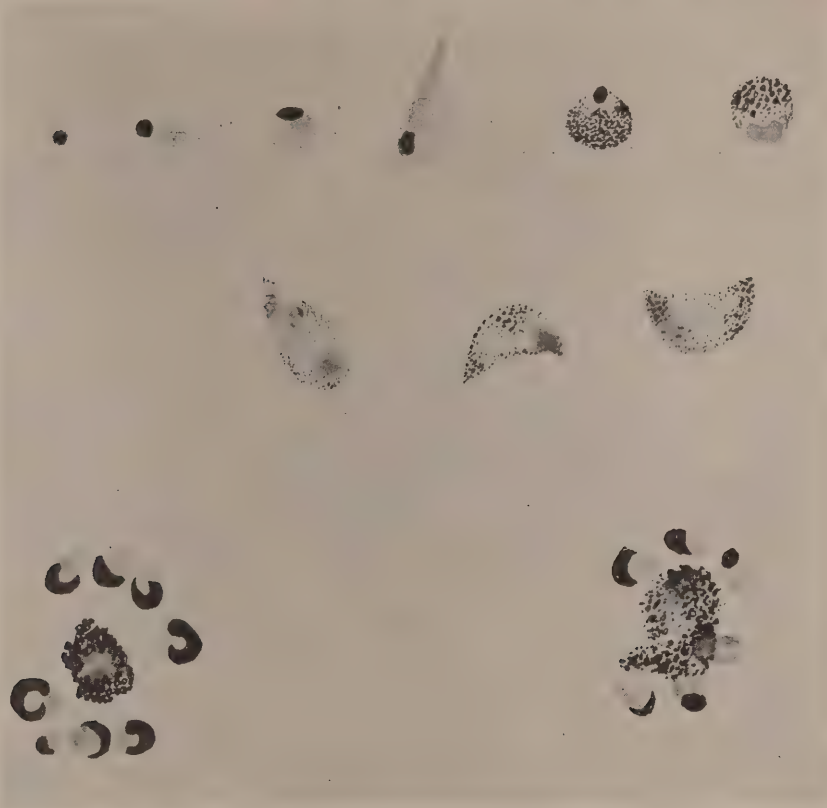


PLATE 4

A THICK BLOOD FILM FROM WHITE THROATED MONKEY 89

This film was stained for one hour in an aqueous solution of Giemsa's stain. Note the trophozoites in the top row which contain abundant coarse pigment, and the band-like forms in middle row. The segmenting forms show 6 and 8 merozoites. This species resembles *P. malariae*.

*rhesus*). This monkey had lived in the outdoor cages of the Board of Health Laboratory at Ancon, Canal Zone, for almost ten years and had been used in experiments concerning relapsing fever when she first arrived on the Canal Zone.

f. Sets of tissue specimens were taken from each monkey for histopathological study. The examination of these specimens is incomplete at present and will not be included in this preliminary report.

All of the blood and tissue films have been searched for any form of parasite that might be revealed by these methods and the results are given in table 2.

None of the inoculated guinea pigs nor the inoculated monkey (*Macacus rhesus*) have shown any of the parasites found in these wild monkeys in their daily blood films up to the end of August, a period of a month and a half following the first inoculations. The guinea pigs were the only available animals for



PLATE 5

This plate shows rib marrow and spleen films from white throated monkey 89. The cell in the lower right corner is a pigmented cell from the spleen. Wright's stain.

use in attempting to secure trypanosome strains. The Old World monkey seemed a likely host for New World monkey parasites but it may have acquired similar infections in early life and established a relative degree of immunity. Furthermore, it is possible that the post mortem state of the blood from the wild monkeys defeated our efforts.

A juvenile white face monkey (*Cebus capucinus imitator*) was brought back in good condition. It has shown daily a light trypanosome infection and a

direct transfer of its blood to the *Macacus rhesus* again produced a refractory result.

A complete study of the parasites found in these monkeys will necessarily require the capture of live monkeys possessing these infections. It is highly probable that all the parasites found are specific for the monkeys and some of them probably for certain species of monkeys. Nevertheless, it is desirable to attempt transfers to man and certain domestic animals.

The monkey malaria appears to be somewhat different in character in the red spider and white throated monkeys. The red spider monkey shows parasites that closely resemble *P. vivax*. The rings are rather large and have but one dot of chromatin. The old trophozoites are irregular in shape and the red blood cell is enlarged and pale. The gametocytes are large round, oval or pear shaped. Segmentation occurs in the peripheral blood and deep tissues, however, the merozoites range from 10 to 14 in number and this is about half the number found in *P. vivax* in man. No Schüffner's dots were found.

The white throated monkey showed parasites that more closely resembled *P. malariae*. That is, the pigment was more abundant, the old trophozoites were inclined to be band-like and the red cells were not increased in size nor decolorized to the extent noted in the other species of monkey. The adult asexual parasites did not fill the red cells. The merozoites numbered 6 to 12, usually 6, 7 or 8. It will be necessary to learn more about the complete cycles before attempting definite statements as to the species of these parasites.

The red spider monkeys, as a general rule, showed marked splenic enlargement and deep pigmentation of the viscera.

The white throated monkey, in some instances, revealed the same.

The Titi monkey failed to show pigmentation or splenic enlargement.

No opportunity was afforded to examine the organs of the black howler monkeys.

#### SUMMARY

1. Goldman (6) lists ten monkeys for the Republic of Panama. Four of these are included in this survey.

2. *Ateles geoffroyi*, the red spider monkey, revealed tertian-like malaria parasites and microfilaria but none of the 24 monkeys showed a trypanosome.

3. *Cebus capucinus imitator*, the Panama white-throated monkey of Chiriqui, revealed quartan-like malaria parasites, a large trypanosome and microfilaria.

4. *Saimiri orstedii orstedii*, the Titi monkey of Chiriqui, revealed no malaria parasites but did show a large trypanosome and microfilaria.

5. *Alouatta palliata insonans*, the black howling monkey, revealed trypanosomes but no other blood parasites in the 4 specimens examined.

6. The autopsy examination of these monkeys (Howling monkey not subjected to this examination) revealed adult filaria in large numbers in the abdominal cavity of the red spider and white throated species but no adults were found in any of the cavities of the Titi monkeys.



7. *Macacus rhesus*, an adult female monkey was inoculated with a total of 5.75 cc. of defibrinated blood from 60 monkeys, 7 red spider monkeys contained malaria parasites and 8 additional ones revealed phagocytized pigment, 3 white throated monkeys contained malaria parasites and 6 additional ones showed phagocytized pigment. This monkey (*M. rhesus*) has shown no sign of illness, no elevation of temperature and no parasites in the period of six weeks following her inoculations. No trypanosomes have been seen in her blood films although she was inoculated with positive blood from three species: red spider, white throated and Titi monkeys.

8. Nearly all the monkeys showing malaria parasites in the blood or spleen films were infants, juveniles or adult females that were pregnant. No severe infections were found. The thick blood film and films from the spleen and rib marrow were the most valuable films used in this survey. Such films were not used in the Chagres River surveys and this, no doubt, accounts for the failure to find light infections in the adult monkeys.

9. Guinea pigs inoculated with blood from the same three species of monkeys also failed to show a trypanosome infection during the six weeks following the inoculations.

10. The hunters encountered the white throated monkeys 9 times, the red spider monkeys 7 times, the Titi monkeys 5 times and the black howling monkeys 2 times. Whether this represents as many separate colonies of monkeys one can not say, but the monkeys found positive for malaria, trypanosomes and microfilaria were not confined to the captures of any one or two days.

11. The monkey should afford a better animal for research work in malaria than the bird since it supplies a larger volume of blood than the bird, a type of blood cell more closely resembling man and species of plasmodia that are difficult to distinguish from the benign species found in man.

12. Some experiments in the transfer of monkey malaria to man have proven refractory in the Eastern hemisphere yet it would seem proper to repeat this work in our region if an infant monkey with an acute initial infection can be taken alive. Similar efforts with the trypanosomes should be made against the horse.

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SURVEY PARTY AT WORK IN THE GUATEMALA DIVISION



### TYPICAL SCENE DURING MALARIA FIELD-SURVEYS

ALL INHABITANTS OF A CAMP SUBMIT TO BLOOD TESTS, AND THOSE FOUND POSITIVE FOR MALARIA PARASITES RECEIVE QUININE AND PLASMOCHIN TREATMENT. THIS IS ONE OF THE TWO MOST IMPORTANT MEASURES IN MALARIA-CONTROL WORK. (See ILLUSTRATION ON OPPOSITE PAGE.)





### TYPICAL SCENE IN ANTI-MALARIAL WORK

ALL BODIES OF WATER ARE CAREFULLY INSPECTED FOR LARVAE, AND THOSE FOUND BREEDING ARE TREATED WITH PARIS GREEN OR OTHER LARVICIDAL AGENTS. THIS MEASURE AND THE FIELD SURVEYS (SEE ILLUSTRATION ON OPPOSITE PAGE) CONSTITUTE THE TWO MOST IMPORTANT MEASURES IN MALARIA-CONTROL WORK



TEMPORARY CAMP DURING PIONEER WORK FOR PARTY ENGAGED IN LAYING PIPE LINES FOR  
WATER SUPPLY





PRELIMINARY WORK IN DEVELOPING A BANANA PLANTATION—CLEARING THE AREA OF THE  
VIRGIN FOREST





### CONSTRUCTION OF A "DRAG-LINE" DITCH

THESE DITCHES DRAIN LARGE AREAS OF POTENTIAL MOSQUITO-BREEDING BODIES OF WATER, AND THEIR IMPORTANCE IN MALARIA CONTROL WORK CANNOT BE OVER-ESTIMATED



SURVEYING PARTY OCCUPIED IN DIRECTING "DRAG-LINE" DITCH CONSTRUCTION IN THE GUATEMALA  
DIVISION





OLD TYPE OF MUD, PLASTER AND ZINC LABORERS' BARRACKS IN THE JAMAICA DIVISION





NEW TYPE OF LABORERS' BARRACKS BEING CONSTRUCTED ON ALL FARMS IN THE JAMAICA DIVISION



OLD TYPE OF IRRIGATION CANAL IN THE JAMAICA DIVISION, WHICH RESULTED IN MANY MOSQUITO-  
BREEDING POOLS AND PUDDLES

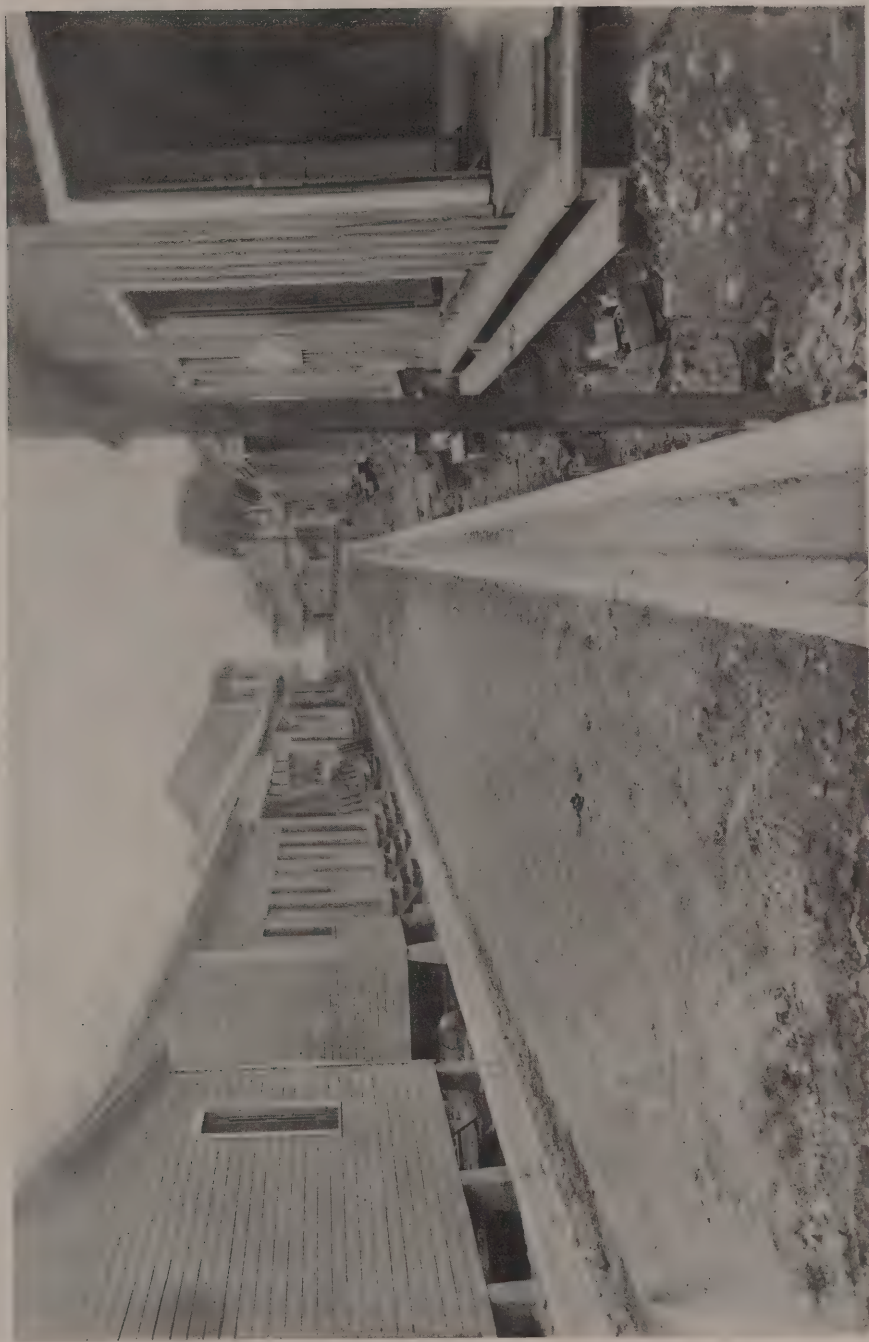


NEW TYPE OF CONCRETE IRRIGATION CANAL IN THE JAMAICA DIVISION, WHICH GREATLY FACILITATES  
MALARIA-CONTROL WORK





GROUP OF LABORERS' BARRACKS IN THE TRUXILLO RAILROAD COMPANY DIVISION



TYPE OF DITCH CONSTRUCTED IN THE TRUXILLO RAILROAD COMPANY DIVISION TO IMPROVE SANITARY  
CONDITIONS



### GROUP OF LABORERS' HOUSES IN THE BANES DIVISION

EACH HOME ADJOINS A PLOT OF GROUND ALLOTTED FOR THE USE OF THE OCCUPANTS. THESE GARDENS PRODUCE SUFFICIENT FRESH FRUITS AND VEGETABLES FOR THE FAMILIES, AND THE HEALTH OF THE INHABITANTS HAS IMPROVED SINCE THE INAUGURATION OF THIS POLICY





PHOTOGRAPH OF A GROUP OF NATIVE CHILDREN TAKEN DURING HOLIDAY FESTIVITIES IN THE  
GUATEMALA DIVISION



SCHOOL-HOUSE IN THE NEW CHIRQUI LAND COMPANY DIVISION  
ELEMENTARY INSTRUCTION IN HYGIENE AND SANITATION IS INCLUDED IN THE CURRICULUM



## SECTION III

## DO WE SEE GOUT IN THE TROPICS?

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Writing in Reynold's System of Medicine, in 1880 (the original essay was written in 1860) Sir Alfred Baring Garrod defined regular gout as, "*A specific form of articular inflammation invariably accompanied with uric acid in the blood, and the deposition of urate of soda in the affected tissues.*"

He took note also of inflammation of non-articular tissues, likewise of disturbance of function of various organs, and associated with the same abnormal state of the blood. Garrod was the originator of the famous thread test for uric acid in the blood, and his references to this substance imply an excess, not a normal quantity.

In 1926, Dr. Thomas B. Futcher, in the latest revision of Osler & McCrae's "Modern Medicine" defines gout as, "*A disorder of purin metabolism characterized by an excess of uric acid in the circulating blood, and diminished excretion of uric acid in the urine, and, usually by an arthritis, the distinguishing feature of which is the deposition of sodium urate in the periarticular cartilages and tissues.*" Thus the definition of gout has remained almost the same for seventy years.

These definitions, however, are not sufficiently comprehensive, and do not take into account those other salient phenomena of the disease, resulting in an etiological and clinical picture so impressive, that as far back in former eras as there are medical records, these records may be used accurately today for description of this antique as well as modern distress. Gouty deposits are found in the Pre-dynastic mummies of Ancient Egypt, according to Garrison (1917), and became more common as more luxurious habits were formed. Hippocrates, Celsus, and Galen wrote of gout, as did other medical immortals from their times down through the ages. Sydenham's famous treatise in 1683 is not excelled in accuracy of shrewd observation by any writer, ancient or modern. He ought to have known, he had suffered with it for thirty years. Those of us who can hark back to what might be termed the Victorian era of literature for juveniles, well recall the gout that was prevalent among stern fathers, hard boiled guardians, and the British nobility in general, particularly the afflicted Earl in that cherished and refined masterpiece of the middle eighties, "Little Lord Fauntleroy."

Yes, gout is a disease of truly ancient lineage, and a still unconquered warrior



whose armor is but little dented in the age old struggle with mankind. The anguish of the victims of true podagra is as keen in our era as in the palmy days of Greece.

Reference has been made to certain salient phenomena which have stamped gout with an individuality that has persisted through the centuries. These are generally accepted by authorities as pathognomonic, and may be summarized as follows:

- (1) True podagra, or inflammation of the foot, especially the metatarso-phalangeal joint of the great toe, with periodic and seasonal recurrence.
- (2) Gouty arthritis, due to the presence of urate deposits in the joints and elsewhere, frequently in the tendons and aponeuroses, and under the skin, where they are known as "Tophi."
- (3) Excess in food and drink, particularly in the indolent and well to do.
- (4) Heredity.
- (5) Preponderance of the disease in males over forty, and its rarity in women.
- (6) Since the introduction of the Folin-Wu method of determining the quantity of uric acid in the blood, the constant presence of this, between and during the attacks, at a level considerably above the normal.

I do not propose to go into the etiology of gout, nor indeed even a clinical description of it, more than is necessary to determine its presence or absence in tropical countries, particularly those of Central and Northern South America, since this is so readily accessible in any standard text book.

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Podagra, defining this term as gouty arthritis of the foot, particularly of the metatarso-phalangeal joint of the great toe, is the outstanding symptomatic feature of the disease. Sydenham begins his description of regular gout with a minute account of this seizure. A striking characteristic is that it attacks men in apparently good health, during the early hours of the morning. Women, when gouty, often escape this particular manifestation. The joint on the left side is said to be more frequently involved, but Williamson, (1920), found otherwise. Garrod quotes his contemporary, Sir. C. Scudamore's figures, which show that in 512 cases of gout, at the first seizure the great toe was implicated in 373 cases, or 73%; and in 341 of these, or 66%, one or other, or both great toes were affected, to the exclusion of other parts. Brugsch (1912, 1915) gives 58%, and Lindsay (1913) 52%. This last however, includes 14% of women in his series, and the accuracy of diagnosis with respect to these has been questioned. Moreover, when there is a gouty polyarthritis, the great toe is involved in an immense majority of cases. In his very careful survey of 116 cases in the Cook County Hospital in Chicago when the joint first affected could be determined, Williamson (1920) found this to be the great toe in 88%, but he also noted the right toe was involved a little more than four times as frequently as the left. 95% of the

patients had the great toe involved sooner or later. In most of these patients the onset was in the night, and sudden. The spring and fall incidence was greater than that of the summer and winter, a fact noted since the time of Hippocrates.

In the Medical Clinics of North America for March 1925 and May 1925 are two admirable articles on gout, by Dr. Hilding Berglund and Dr. Joseph H. Pratt, respectively, but these authors do not give the frequency of podagra. Fitcher states only that the metatarso-phalangeal joints of the big toes are most commonly involved. Acute infectious arthritis, while often involving the joints of the feet, does not show nearly so great a selectivity for one particular location. The periodicity of the attacks of podagra, and the general good health, during the intermissions, before the gout becomes chronic, and associated cardio-vascular-renal disease sets in, are also noteworthy points.

Second in importance is the formation of the tophi and the deposits of urates in the joints. Sooner or later the latter are found in all cases of gout. The presence of tophi, while not so constant, must be demonstrated in a large percentage of any series of cases reported as gout, if the diagnosis is to be accepted. Dr. Pratt calls attention to the absence of this percentage in some series, and very justly remarks that the "*critical student before attaching importance to his conclusions, would like to have doubts regarding the accuracy of the diagnosis removed.*" Where the tophi have been especially sought for and demonstrated they have been found in from 52 to 60% of the cases. Pratt states that in 126 cases in which the location of the tophi was reported, in 118 or 94% they were found in the ears. The great toes, the olecranon and patellar bursae, and the fingers are sites in which tophi are frequently found. Heberden's nodes, especially in women, are frequently mistaken for tophi.

Among the well to do classes, gout has always been associated with over-indulgence in rich food and excessive abuse of alcohol, particularly the heavy wines such as port and madeira. Sydenham (1683) states, "*It attacks those aged persons, who have spent most part of their lives in ease, voluptuousness, high living and too frequent use of wine and other spirituous liquors and have entirely left off those exercises which young persons commonly use. But what is a consolation to me, and may be so to other gouty persons of small fortunes and slender abilities, is that kings, princes, generals, admirals, philosophers and several other great men, have thus lived and died. In short, it may, in a more especial manner, be affirmed of this disease, that it destroys more rich than poor persons, and more wise men than fools.*"

Gout however, is not confined to the rich. A high proportion of the cases in the series reported from various hospitals is among the laboring classes. Osler said that "*poor man's gout is a common affection,*" and he attributed its frequency in England to poor food, defective hygiene and excessive consumption of malt liquors. Niemeyer (1876) writing from his experience in Germany and Austria states, "*Among poor folks it is so rare that the disease is hardly ever seen in the hospital.*" Williamson's observations are most interesting. His 116 cases as noted, were patients in the Cook County Hospital. He states, "In a

class of patient in whom want and privation might be reasonably supposed to play an important rôle, we find no evidence of this in our series. 92 of 101 patients, in whom the nutrition was particularly noted were well nourished and in most instances well built."

Alcohol is a very striking predisposing factor. Williamson's series was collected before the "*noble experiment*" went into effect. 62 of his patients, or 53%, were heavy drinkers, 41 or 36% were moderate drinkers, meaning by the term moderate that they probably took plenty. Nine patients drank a little, and only four, or 3% drank little or no alcohol. Thus 89% of the series gave a very definite history of free use of alcohol. Even before prohibition these figures are more than suggestive. Williamson stated that there was no difference in the gout of those who drank whiskey alone, or those who drank beer alone, but the latter were more numerous. The evidence points to two classes of gouty patients, one is the well-to-do, living on rich food and heavy wines. The other drinks malt liquors in considerable amount but among it influence of food is indeterminate.

Heredity is a factor of prime importance among the high living and indolent class. All writers, ancient and modern, agree on this. Particularly in England is it true, and plays a part in from 50 to 75% of cases. Extrinsic causes, however, seem to predominate in causing "poor man's gout." Here heredity is not much in evidence. The difficulty of obtaining clear cut family histories among the laboring class may account partly for this.

The authorities also, are in agreement that women are very little subject to gout, even in gouty families. So strongly is this belief held, that in any series of cases reported as gout, which includes 10% or more of women, the accuracy of the diagnosis is under suspicion.

If, perhaps, I have dwelt too much at length on the factors concerned in the etiology and symptomatology of gout, it is because I hope to present a reasonably definite outline of what to expect, if we really do see gout in the Tropics. We must look for more than arthritis with hyperuricemia. We must demonstrate in our findings high percentages of true podagra, and the occurrence of tophi. Alcohol, heredity, and especially a very low percentage of cases in women, must show as determining factors. What Fletcher calls a "nondescript group of symptoms" associated with the term irregular gout, cannot be accepted as evidence in favor of true gout, unless these symptoms occur in patients who belong to gouty families, or who have undoubtedly themselves suffered with gout. Migraine, muscular rheumatism, rheumatic or infectious arthritis, numbness and paraesthesias should not be mistaken for gout. They are frequently associated in my personal experience, as shown in Dr. Guardia's tables (p. 122) with a moderate hyperuricemia, but here the level of the blood uric acid falls considerably below that found in proved gout.

The etiological relationship between hyperuricemia and gout is still an unsolved problem. Some authorities, such as Pemberton (1929) are doubtful as to



the constancy of this relationship, and he states that "*the accompaniment of gout by increase in the blood uric acid is nearly as often lacking as present.*" The only comparative tables I could obtain were those of Berglund reproduced in the accompanying paper by Dr. Guardia (p. 121), and our own arthritis series, comparable to Berglund's non-gouty arthritis series. In a small series of 5 cases reported by Rentschler (1928) of the Mayo Clinic, the uric acid was over 6 mg. in all. In this series the remarkable fact was disclosed that the earliest diagnosis was made from three and a half to thirteen to seventeen years after the initial attack, and this latter was a true periodic podagra in three of the five.

It may be stated that much of the recent work on the blood uric acid in gout and arthritis has been done in the United States. In that country the trend of opinion is in favor of hyperuricemia as an essential factor in gout. I have tried to find tables comparable to Berglund's No. 1 and No. 2, and Guardia's No. 3 and No. 5, but without success. Several writers point out the hyperuricemia of terminal nephritis. Modern authorities are inclined to believe that in gout the kidney is insensitive to the passing of blood uric acid, rather than impermeable. Berglund points out that the acute gout attack is not accompanied by any change in the usual uric acid level in the patient's blood. He injected considerable amounts of uric acid intravenously during the height of the attacks, and not only were the symptoms not aggravated, but the attacks subsided in 24 hours, and the patients often thought the injections had a rather good therapeutic effect.

There is no agreement as to the value of the X-ray diagnosis and for that reason I do not refer to it in this contribution.

Most writers today class gout among the Diseases of Metabolism. These are: Diabetes Mellitus, Diabetes Insipidus, Gout, Obesity, and Marasmus.

Four of these are fairly common in the American Tropics, probably as much so as in Europe and the United States. Gout however, seems to be conspicuous by its absence. For over three hundred years the British, French, and Dutch have been colonizing the tropics, and every year a fresh supply of military and naval, civil and administrative officials have been sent out from home. Their diet, for the past three centuries, as far as I can make out from reading and personal correspondence, is certainly not one to inhibit gout. It is, and has been, anything but balanced, as we use the term today. Perhaps not so much wine and spiritous liquors are used at present as one hundred years ago, but only under the star spangled banner of liberty are the inhabitants of tropical countries supposed to be suffering from internal drought, and not too much, in those over which it waves.

For many years the type of military or civil official sent out from England has belonged to the class in which at home heredity gout prevails to no small extent. I wrote to Dr. Philip Manson-Bahr requesting information as to his knowledge of gout in the tropics. He replied that gout is practically unknown in British tropical possessions. The text books on Tropical Diseases do not mention it, not even as the result of high living and free drinking, although the other

dangers and sequelae of these pleasant but unprofitable habits are set forth plainly enough to satisfy any Temperance Society.

There is no reference to gout in the Proceedings of the Royal Society of Tropical Medicine and Hygiene in the 22 years of its existence,\* although the cosmopolitan diseases are frequently mentioned. I cannot help but feel that if gout were at all prevalent in the Old World tropics, it would be at least included in the catalogue of troubles that follow departure in these climates from the straight and narrow path. There are plenty of these troubles so listed and they are not all peculiar to the Torrid Zone.

Those hardy pioneers from the Iberian peninsular who colonized the American Tropics lived nobly and well, and their descendants have not fallen behind the ancestral example. The diet of Latin-Americans consists and has consisted of proteid and carbo-hydrate to a large degree. The purin-containing foods, kidneys, sweet breads, liver and brains are highly regarded and partaken of liberally. Men and women are fond of wine; and port, sherry and the heavy sweet wines are generally esteemed. According to Dr. R. Santos (1920) gout is not uncommon in Spain, and the factor of heredity cannot be discounted. Exercise, also is not any too popular in Tropical Latin-America. But while the diagnosis of gout is rarely made in other tropical countries, it is, rather indirectly, frequently met with under the guise of uric acid diathesis and uric acid arthritis, in Central and Northern South America.

The reason why the arthritic patients who come to the Herrick Clinic, in Panama, frequently request blood examinations, is that they have been told they have hyperuricemia as a cause of their trouble. The same is true of those complaining of the paresthesias, hyperesthesias, muscular pains and cramps, which are so common. Especially Bernhart's paresthesia, or the numbness, pain on exertion and hyperesthesia along the distribution of the external cutaneous nerve of the thigh, is frequent, and usually attributed to excess of uric acid in the blood. Many of the arthritides of the hands, with Herberden's nodules, especially among women, are diagnosed as gout.

But true gout is so rare that in 24 years practice in Panama and the Canal Zone I have seen only two cases, and both of these imported. I have been unable to build up a series of monarticular or polyarticular arthritides that includes the real salient clinical phenomena of the disease. In over 300,000 admissions to the Gorgas Hospital in 26 years there are recorded only two cases of Gout and one of these is doubtful, while the other was in a North American.†

Blood chemistry work for The Herrick Clinic was done under the competent direction of Mr. J. E. Jacob, Chemist of the Board of Health Laboratory of the Gorgas Hospital, for ten years, and since July last, by Dr. Lawrence Getz, Chief of the Panama Hospital Laboratory.

\* I am indebted to Dr. Philip Manson-Bahr for his kindness in having this fact verified.

† Major H. C. Dooling, Chief of Medical Service, Gorgas Hospital was kind enough to obtain this information for me.

The results are remarkably constant, and the polyarthritides and the paresthesias do not show the hyperuricemia of gout and terminal nephritis.

Just why true gout should be so uncommon in the American tropics, where there are not only present, but prevalent as well, the etiological factors for its existence, I do not know. The hypothesis of super-abundant excretion of uric acid through the skin does not appeal to me for several reasons, one of which is that no inconsiderable proportion of the inhabitants of Central and Northern South America does not live in a sea-level tropical climate, but in the higher elevations, where there is no excessive skin elimination, and the weather is periodically cold and damp. Then, there is also, Berglund's observation, that the level of the hyperuricemia is not diminished during the acute phase, while throwing an artificial increase of uric acid into the blood stream does not augment the symptoms.

Over 250 years ago Sydenham noted that "*Travelling into southern countries is so effectual to conquer those diseases, the cure whereof is fruitlessly attempted in a colder climate.*"

It is singular that the freedom from gout which exists in the tropics has not been noted and taken into account by specialists in the disease. Garrod, it is true, noted the favorable influence of hot climates and attributed it to a more active function of the skin. After reading of the suffering caused by chronic gout, one is led to believe that if a certain climate can relieve or alleviate the symptoms, it might at least be tried. As far as I know, not much work on the quantity of blood uric acid, and its relationship to the regular, and also the so-called irregular forms of gout, has been done in the Tropics. However, in the Medical Service of the Herrick Clinic an attempt has been made during the past ten years to ascertain if there is evidence of such relationship. In a large proportion of our arthritic cases the uric acid level was low, and in none of these, nor in any selected series, was hyperuricemia demonstrated, as Berglund and others have demonstrated it in gout. I have no doubt but that what is called the uric acid diathesis in Central and Northern South America is due mostly to faulty diet and focal infection, and has nothing whatever to do with any form of true gout. Dr. Herbert Clark, now Director of the Gorgas Memorial Institute in Panama, told me that during his ten years service as pathologist in the old Ancon, now the Gorgas Hospital in the Canal Zone, it was his custom at autopsy to open all suspicious joints, and he never encountered gouty arthritis.

Most of us who do laboratory and clinical work in the Tropics are too busy with our own problems to tackle those of Temperate climates, but the absence of gout in our jurisdiction offers a very pretty problem for the worker who may someday try to solve it.

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## A STUDY OF 980 CHEMICAL ANALYSES OF THE BLOOD, WITH SPECIAL REFERENCE TO HYPERURICEMIA

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The following tables have been prepared with a view to showing what relation, if any exists between hyperuricemia and certain symptoms which may or may not be due to gouty diathesis as seen in the American Tropics.

There were collected 980 reports of blood chemical analysis done in the Laboratory of the Gorgas Hospital for the most part, and the remaining few in the laboratory of the Hospital de Panama. These reports were the result of requests for blood chemical analysis sent from the Herrick Clinic to these laboratories in the course of ten years, from 1920 to 1930.

The first two tables are copies of tables which appeared in the March number of the Medical Clinics of North America of 1925, by Dr. Hilding Berglund, and show, Table 1, cases of gout, and Table 2, cases of chronic arthritis.

According to Berglund "*gout cases with normal uric acid are very scarce*;" but we wanted to be generous and to add to our list any possible cases of gout that could be found. Thus we looked for all the cases with uric acid in the blood above 3 mg. per 100 c.c., accompanying symptoms of arthritis, paresthesias such as tingling, numbness, itching, coldness, and nodules in ears or elsewhere which might be taken as tophi. There were among the 980 blood chemical reports, 50 such cases. We placed in one list, Table 3, those cases with arthritis; in another, Table 4 those with paresthesias and without arthritis; and in another Table 5, those with nodules in the ears.

For comparison, we looked among the rest of the blood analyses, for all those that had uric figures above 5, and none of the symptoms above referred to, and

TABLE 1

DR. BERGLUND'S CASES. SHOWING ELEVATED PLASMA URIC ACID IN ALL DEFINITE CASES OF GOUT

Notice the last case is the only woman in the series. The diagnosis in the last and next to last cases remains doubtful.

Case	Age	Plasma Uric Acid per 100 c.c. Mg.	Plasma N.P.N. per 100 c.c. Mg.	Remarks
23,035, Mr. G-r . . . . .	70	14.7	34	
21,061, Mr. K-z . . . . .	38	10.7	25	
—, Dr. S-n . . . . .	29	9.6	24	
10,966, Mr. H-n . . . . .	43	9.6	46	
L. I. H., Mr. B-e . . . . .	50	9.3	49	
22,896, Mr. B-th . . . . .	48	9.2	34	
23,179, Mr. S-ds . . . . .	68	8.9	48	
23,189, Mr. G-y . . . . .	56	8.6	30	
—, Mr. W-r . . . . .	54	8.4	26	
22,874, Mr. M-th . . . . .	50	8.2	29	
—, Mr. T-y . . . . .	39	7.9	44	
—, Mr. M-n . . . . .	65	7.8	28	
—, Mr. L-d . . . . .	57	7.5	30	
21,380, Mr. B-l . . . . .	41	7.4	25	
—, Mr. H-d . . . . .	68	7.2	27	
25,021, Mr. K-er . . . . .	65	6.6	27	
23,231, Mr. B-k . . . . .	53	6.5	31	
25,114, Mr. S-lo . . . . .	38	5.8	35	
Same a year later . . . . .	39	3.5	23	Two cases where the diagnosis of gout remains doubtful in the absence of tophi
Mrs. L-g . . . . .	..	4.6	23	

TABLE 2

DR. BERGLUND'S CASES. SHOWING IN 19 CASES OF CHRONIC POLYARTHRITIS. THE PLASMA URIC ACID ALWAYS BELOW UPPER NORMAL LIMIT

The cases are all typical cases, either primary chronic or developed out of an acute onset. Note 11 cases out of 19 are women.

Case	Age	Plasma Uric Acid per 100 c.c. Mg.	Plasma N.P.N. per 100 c.c. Mg.
L. I. H., Mr. D-y . . . . .	55	2.2	20
" Mrs. R-n . . . . .	45	2.2	21
" Mrs. Z-k . . . . .	44	2.2	29
" Mrs. Rd-n . . . . .	60	2.4	22
" Mr. F-n . . . . .	55	2.5	27
" Mrs. D-y . . . . .	50	3.3	22
—, Mrs. S-ch . . . . .	40	3.6	19
—, Mrs. H-y . . . . .	27	3.7	25
—, Mrs. S-ky . . . . .	50	3.8	29
—, Mrs. X-y . . . . .	38	3.9	19
—, Mrs. G-n . . . . .	32	4.0	21
—, Mrs. H-y . . . . .	45	4.0	27
L. I. H., Mr. B-n . . . . .	37	4.1	32
—, Mrs. R-y . . . . .	38	4.2	32
—, Mr. B-k . . . . .	50	4.4	27
L. I. H., Mr. T-r . . . . .	20	4.5	20
—, Mr. OB-n . . . . .	45	4.8	22
—, Mr. B-e . . . . .	59	5.5	29
L. I. H., Mr. P-s . . . . .	79	5.8	39

placed them in Table 6. There were 47 such cases. The majority of the cases including those of Table 6 had some other accompanying condition that showed

TABLE 3

HERRICK CLINIC CASES. ARTHRITIC CASES WITH URIC ACID ABOVE 3 MG. PER 100 C.C. OF BLOOD—TOTAL 38 CASES, MEN 25—WOMEN 13

Case	Plasma Uric Acid per 100 c.c.	Plasma N.P.N. per 100 c.c.	Remarks
	Mg.	Mg.	
F. G. . . . .	3.1	22.5	
M. C. . . . .	3.3	42.0	
J. de C. . . . .	3.4	21.9	Focal infection
A. C. . . . .	3.4	43.2	Focal infection
L. A. . . . .	3.4	31.2	
D. M. . . . .	3.5	44.5	Arterio-sclerosis
A. G. . . . .	3.5	24.2	Nephritis
J. C. . . . .	3.6	33.3	Diabetes
P. M. D. . . . .	3.6	25.5	
C. B. . . . .	3.6	26.4	
M. G. . . . .	3.8	45.3	Nephritis
W. H. . . . .	3.9	28.8	
J. J. A. . . . .	3.9	20.5	Nephritis
R. Ch. . . . .	3.9	25.8	
L. L. . . . .	4.0	25.3	
T. de A. . . . .	4.0	38.0	
R. T. . . . .	4.0	36.1	
C. Ch. . . . .	4.0		
P. A. R. . . . .	4.1	33.5	Obesity
C. C. . . . .	4.1	38.5	
V. E. . . . .	4.1	31.8	
P. M. . . . .	4.2	26.3	
W. H. P. . . . .	4.2	28.4	Hypertension
F. E. . . . .	4.2	23.8	
T. G. . . . .	4.4	32.0	
M. D. . . . .	4.4	28.3	Gonorrheal infection
V. R. . . . .	4.5	50.3	Obesity
T. L. . . . .	4.7	31.5	Obesity
R. T. . . . .	4.7	39.7	Focal infection
S. M. . . . .	4.8	35.1	Obesity
J. C. M. . . . .	5.0	30.3	Diabetes
E. R. . . . .	5.0	42.0	Focal infection
A. D. I. . . . .	5.0	37.8	
F. L. . . . .	5.5		Arterio-sclerosis
A. C. . . . .	5.8		Focal infection
C. C. . . . .	6.6	29.7	Myocarditis
L. L. . . . .	7.1	33.0	Nephritis

faulty metabolism or impaired renal function, especially as the higher figures are approached. Berglund considers 6 mg. uric acid per 100 c.c. of blood as the upper



limit of normal, and all cases with that amount or more in these lists had disease of the circulatory or renal apparatus, had diabetes or were obese; but it should be borne in mind that blood chemical analyses are usually done precisely in such cases, and hence they are bound to be numerous in any analysis such as this so-called one. In fact relatively few of these blood analyses, perhaps only those that do not show any other accompanying condition, were done because gout was suspected.

None of these tables are comparable with that of Berglund's cases of gout which show uric acid figures from 14.7 to 3.5, with a mean higher than those shown in any of our tables.

TABLE 4  
HERRICK CLINIC CASES. NON-ARTHRITIC CASES WITH PARESTHESIAS—URIC ACID ABOVE 4—10 MALES

Case	Plasma Uric Acid per 100 c.c.	Plasma N.P.N. per 100 c.c.	Remarks
	Mg.	Mg.	
M. D. H. . . . .	4.2	35.0	Obesity, hyperglycemia
C. B. . . . .	4.4		
G. Ch. . . . .	4.6		
E. G. F. . . . .	5.5	31.3	C. nephritis
J. I. . . . .	5.5		Arterio-sclerosis
W. H. C. . . . .	5.7	40.6	Arterio-sclerosis
E. L. . . . .	5.8	36.3	Mitralregurg.
C. R. . . . .	6.0	20.5	C. nephritis
E. D. . . . .	6.4	47.6	Diabetic
L. R. . . . .	8.0	28.6	Atophan, no effect

TABLE 5  
CASES SHOWING NODULES IN EARS NOT REGARDED AS TOPHI. TOTAL 3 CASES

E. M. V. . . . .	4.1		Included in arthritic cases
A. M. . . . .	6.0	32.3	Hypertension
E. P. . . . .	4.2	32.1	Hypertension
			All males

Table 3 of the arthritic cases, shows higher uric acid figures, ranging from 3.1 to 7.1, than Berglund's tables which go from 2.2 to 5.8 in a lesser number of cases, and again, while in his table the majority are women, 11 out of 19, in ours the majority are men, 25 out of 38, which is just the opposite, and which might be taken to suggest that the later cases are not so removed from the gout class as the former. In only one of these cases, D.M., do we have an X-ray report that speaks of *gouty* deposits and shadows.

The cases with paresthesias, Table 4, show a higher uric acid in the blood than the arthritic cases so that uric acid may be said, according to this table, to have more relation to paresthesias than to painful joints. It is worthy of notice that all are males on this list.

There were three cases showing nodules in the ears, Table 5, none of them dem-

TABLE 6  
HERRICK CLINIC CASES\*

Case	Plasma Uric Acid per 100 c.c.	Plasma N.P.N. per 100 c.c.	Remarks
	Mg.	Mg.	
L. P. . . . .	5.0	37.1	Nephritis
J. D. . . . .	5.0	44.3	Hypertension
E. U. A. . . . .	5.0	32.5	Hypertension
R. G. . . . .	5.0	36.6	Furunculosis
J. M. . . . .	5.0	35.8	Cyst-adenoma of thyroid
M. de P. . . . .	5.0	23.5	Nephritis
S. A. . . . .	5.1	41.1	Prostatitis
H. F. S. . . . .	5.2	45.0	Gonorrheal infection
J. de A. . . . .	5.2	29.1	Nephritis
W. R. . . . .	5.2	30.0	Hernia
A. D. . . . .	5.2	27.4	Endarteritis obliterans
L. K. . . . .	5.2	31.5	Arterio-sclerosis
M. F. D. . . . .	5.2	27.9	Obesity
J. M. . . . .	5.2		Diabetes, nephritis
C. J. . . . .	5.3		Nephritis
N. M. . . . .	5.5	38.4	Psoriasis
C. P. . . . .	5.5	38.1	Hypertension
J. S. . . . .	5.5	27.4	Hypertension
N. B. . . . .	5.5	37.2	Hypertension. Diabetes
J. H. . . . .	5.6	39.9	Diabetes
G. B. . . . .	5.6	33.5	Myocarditis
M. J. . . . .	5.6	29.1	Hypertension
E. A. . . . .	5.6	30.3	Hypertension. Facial paralysis
M. U. A. . . . .	5.7	45.0	Hypertension
J. F. . . . .	5.7		Nephritis
I. P. . . . .	5.7	100.5	Amebiasis, N. retention
M. A. G. . . . .	5.8	30.3	Nephritis. (Dead)
Dr. B. . . . .	5.9	29.0	Tropical liver
G. A. . . . .	6.0	26.7	Diabetes. Arterio-sclerosis
L. C. . . . .	6.0	34.3	Diabetes
J. D. A. . . . .	6.1		Obesity
C. G. . . . .	6.1	151.5	Nephritis
L. H. N. . . . .	6.1	44.3	Nephritis
G. deG. . . . .	6.1	31.7	Obesity
M. P. . . . .	6.5	33.1	Hypertension
S. L. . . . .	6.5	41.0	Nephritis
P. R. . . . .	6.7	30.2	Arterio-sclerosis
V. V. . . . .	7.0	44.0	Nephritis. (Dead)
T. G. L. . . . .	7.1	28.2	Nephritis
P. C. . . . .	7.8	11.2	Arterio-sclerosis. Diabetes
N. C. . . . .	8.0		Nephritis. (Dead)
F. S. . . . .	8.2	34.1	Diabetes. Hypertension
J. S. D. . . . .	8.0	31.0	Dyspepsia
W. B. . . . .	7.9	56.4	Nephritis
F. K. O. . . . .	8.8	42.0	Nephritis
R. B. . . . .	9.9	65.0	Hypertension
F. A. . . . .	14.2		Nephritis. (Dead)

\*Cases with uric acid above 5 mg. per 100 c.c. of blood not showing gouty symptoms } Men 40, Women 7

onstrated to be tophi. The first, E. M. V., is the only one in the whole series that approaches the picture of gout; notably because he complained of gout with recurrent attacks of arthritis, and had a large nodule in one ear. He would have probably been classified as doubtful by Berglund because his uric acid was only 4.1 mg. He was an Englishman.

Table 6 has already been discussed, but it may be added that, if uric acid has any relation to the symptoms which served as the basis for the other tables it would be strange that none of these symptoms should appear, as far as the Clinic record goes, among these cases, which have a higher uric acid. Perhaps the following statement by Berglund has a relative application here, "*Whatever may be the ultimate explanation, the fact remains that the gout patient with 7 mg. uric acid per 100 c.c. plasma shows tophi, while the normal patient with 4 to 5.5 or even 6 mg. does not.*" On the other hand, as the same author implies in another paragraph, impaired renal function leads to a greater uric acid concentration in the blood along with other nitrogenous bodies, than is ever present in gout.

## TREATMENT OF LOBAR PNEUMONIA BY INTRAPULMONARY INJECTIONS OF PATIENT'S WHOLE BLOOD\*

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Therapeutic application of autogenous immunity principles and protective antibodies formulated by pneumococcic infection has frequently been practised in combating post-operative pneumonia, influenzal pneumonia, and, to a lesser degree, lobar pneumonia. To the first of these (post-operative pneumonia) has been applied autohemotherapy (by intramuscular blood injection); influenzal pneumonia has been subjected to treatment by transfusion of convalescent (immune) citrated blood and by injection of convalescent human serum, while a few reports testify to the usefulness of intramuscular injection of patient's blood in lobar pneumonia. The present paper emphasizes the feasibility of introducing whole blood (and other appropriate agents) into an apparently hitherto unutilized zone, the intrapulmonary tissues.

### AUTOGENOUS IMMUNE BODIES

The existence of abundant evidence that human blood serum is endowed with immune substances of varying degrees of resistance during the course of lobar pneumonia furnishes the rationale for all modes of treatment designed to utilize these substances and to enhance their effectiveness.

\* This paper has been accepted for publication in *Clinical Medicine and Surgery*.



Kolmer<sup>1</sup> states that pneumococci produce small amounts of exogenous toxins, larger quantities of endotoxins, and an aggrassin-like substance "S" (Avery) influencing phagocytosis. Recovery from pneumonia, according to this writer, is due largely to the development of protective antibody, just as of primary importance in prognosis are the quantities of the various toxins in lung and blood. Kolmer further attributes the favorable effect of antibody solution or serum upon type IV infection (for which antibody is lacking) to non-specific protein reaction.

Cole<sup>2</sup> supports Tillet's demonstration of "non-type, specific humoral factors" concerned in immunity to the pneumococcus, but restates his conviction of the relatively greater importance of antibodies specific to the existing type and evaluates most highly in prognosis the presence or absence of septicemia. Neufeld and Dochez have shown that when recovery from pneumonia occurs the patient's blood has acquired the same immunological factors contained in immune horse serum. It is not unreasonable to suppose, therefore, that insufficient antibody formation and deficient antibody concentration in the blood and pulmonary tissue are the principal factors in pneumonia mortality.

#### AUTOHEMOTHERAPY

During the past decade in America, little or no attention has been given to the natural immunological substances elaborated during the course of pneumonia. In their stead, interest has been centered upon the typing of pneumococci and the production of specific antisera. MacLachlan and Fetter<sup>3</sup>, McGuire and Redden<sup>4,5</sup> and Ross with Hund<sup>6</sup> reported amazingly good results from the use of convalescent serum, immune citrated blood and whole blood in influenzal pneumonia. These agents were employed intravenously, during the influenza epidemic of 1918, and have since received little or no attention.

It is to European writers that the possibilities of utilizing the inherent immunological properties of patient's blood have most appealed. Autohemotherapy has assumed an important rôle in the treatment of postoperative pneumonia upon the continent; its application having witnessed a gradual restriction from a wide field of infectious diseases, to post-operative pulmonary infections and pneumonia. The sites of blood injection have been almost exclusively intramuscular, but to a very limited extent, intravenous (defibrinated blood).

Belliboni<sup>7</sup> in an extensive review of the earliest literature of autohemotherapy found its chief application in certain forms of tuberculous pleuritis.

The revival of the procedure by Vorschütz and Tenckhoff,<sup>8,9</sup> and its exclusive application to post-operative and lobar pneumonia, has resulted in extensive use of the method; and the reports are generally favorable. Vorschütz and Tenckhoff report 3 lobar pneumonia cases, with favorable termination.

The central interest of these and other continental investigators has been post-operative pneumonia, though Rhode<sup>10</sup> and Kaum<sup>11</sup> report success in the application of autohemotherapy to lobar pneumonia. The former states that

the method is almost always successful in early cases. Favorable reports upon post-operative cases have issued from Graefe<sup>12</sup> and Schaack<sup>13</sup>. Schwartz<sup>14</sup> used autohemotherapy in 120 cases of post-operative pneumonia and bronchitis. Four fatal cases revealed lobar pneumonia at autopsy. He considered that autohemotherapy has reduced the mortality of post-operative pneumonia 75%. Siegenfeld<sup>15</sup> writes that Elfstamet-Grafstom reported the treatment of croupous pneumonia by intramuscular injections of patient's blood in 1898. Siegenfeld recommended injection of not more than 20 c.c. of blood (in order to conform to Schulz-Arndt's law). He strongly favors autohemotherapy as a therapeutic agent, but condemns it is a prophylactic one. Rausche<sup>16</sup> used the method in a controlled series of post-operative cases, the mortality of the one being 4%, and of the other 18% (alternate cases). He proposes the term "therapy with irritant bodies", and attributes much of its effect to the decomposition products of blood albumin acting upon the vegetative nervous system and the reticulo-endothelial system. He found that systemic blood pressure was raised by intramuscular injections and gastric secretion altered.

Konig,<sup>17</sup> on the other hand, is not convinced of the efficacy of autohemotherapy and considers simple bloodletting as effective. Rieder,<sup>18</sup> in a controlled series, concluded that the blood injections had no effect on the characteristically abrupt temperature curve of post-operative pneumonia, and expressed the belief that the method was not effective in the greater number of cases.

These writers support Vorschütz's theory that the action of whole blood when injected intramuscularly is dependent upon albuminous decomposition products (globulins, pseudoglobulins, and euglobulins), and upon the liberation of specific antibodies in the "division" of injected blood.

#### INJECTION OF BLOOD INTO CONSOLIDATED LUNG

It is the writer's premise that whatever virtues—both specific and derivative—obtain in whole blood of pneumonia patients, their application to treatment of the disease is better served by introduction into the diseased pulmonary area than by injection into a distant muscular focus. "Division" of blood must occur as effectively in the former site, and in addition the direct action of available antibody is obtained where its presence in concentration is most urgently required, i.e., where the toxins and endotoxins of pneumonia are in greatest concentration.

Other advantages of delivering blood in extra measure to the afflicted pulmonary area are:

- (1) Restoration of the blood supply of consolidated lung to a volume more nearly approximating that of normal lung.
- (2) Increase of antibody volume delivered to the afflicted lobe in proportion to the increase in blood supply.
- (3) A diminution in the increased hydrogen ion content of consolidated lung by the injection of blood withdrawn from the systemic circulation.

- (4) A mechanical and irritant action resulting from the introduction of blood under moderate pressure. This may be thought to facilitate the loosening of fibrinous intra-acinar exudate and by stimulation of leukocytosis to hasten its liquification.
- (5) The relief of cardiac embarrassment by withdrawal of blood from the systemic circulation and its disposal in the periphery of the lung (where it cannot materially increase blood pressure at the hilus).

#### APPLICATION OF INTRAPULMONARY THERAPY

Accordingly, the writer has subjected 38\* consecutive cases of lobar pneumonia to intrapulmonary injections of autogenous whole blood. This number is of course too small to establish a basis for definite conclusions, but the experience it has afforded yields observations of some interest.

It may confidently be said that this radical method of treatment has not proved injurious. There is, indeed, evidence to indicate that it may be a definite benefit.<sup>19</sup>

#### TECHNIQUE

The skin over the antecubital fossa corresponding to the side of the affected lung is prepared with Tr. iodine and alcohol. A tourniquet is adjusted above the elbow, and 20 c.c. of venous blood are withdrawn into a Luer syringe. The tourniquet is removed, a small piece of gauze is placed at the site of the puncture, the elbow flexed, and the patient turned on his opposite (sound) side by an assistant. The skin overlaying the area to be injected is wiped briskly with an iodine and an alcohol sponge. The needle (of the usual intravenous type, 20-22 gauge) is introduced its full length—with syringe attached—through an intercostal space. Expedition may be assured by using the palpating thumb as a guide. With the shoulder of the needle held firmly against the skin, injection is carried out with ordinary pressure on the piston. Should coughing or deep breathing cause movement of the needle, the injection is immediately halted and the syringe held lightly to facilitate its counter-movement with the needle point. Unnecessary laceration of pulmonary tissue is thus avoided. If draping of the chest is done, it should be performed by an assistant in order that the operator's time may be conserved.

In approximately 80% of injections hemoptysis occurs. This takes place, in most instances, towards the end or after the conclusion of the injection. Should it occur early, the injection need not be discontinued unless coughing is paroxysmal or distressing (in only three of 216 injections). Pain is seldom severe. Coughing may be entirely absent, or may last for 30 minutes or longer. The patient should be advised that some blood may be expectorated after the treatment. Coughing is, of course, more noticeable in pleural involvement, and when opiates have not been employed.

\* From this series are omitted two patients who died 10 and 14 hours after admission, respectively.



It is important to carry out the entire technique with a moderate degree of speed to avoid coagulation of blood\*. Should unusual force be required to complete the injection it should at once be discontinued. (A prohibitive decrease in coagulation time is noted in a small percentage of pneumonia cases.)

If delay in technique has permitted coagulation, blood may be withdrawn and injected with a fresh needle and syringe.

#### ROUTINE INJECTION TREATMENT

In cases of ordinary severity, one injection a day has been employed. In obviously grave cases, two or more have been given. Logically, it would seem desirable to give three or four injections every 24 hours for the first two or three days in early cases. (Unfortunately, very few early cases were available for treatment in this series, the average time of hospital admission or first treatment being 6.2 days after onset of illness.) Severe cardiac embarrassment, marked dyspnea and distress upon turning, and profound depression are contraindications. The technique may be carried out without removing a low back-rest.

An effort should be made to diversify the sites of injection in order that different areas of consolidated tissue may be subjected to therapeusis. In lower lobe involvement, the initial injection is usually made beneath the tip of the scapular angle, succeeding injections in the vertebral and paravertebral lines above and below this level, in the scapular line (9th and 10th interspaces) and in the posterior and middle axillary lines. In upper lobe disease, injections are made posteriorly, anteriorly in the midclavicular line (2nd. and 3rd. interspaces on the right side), in the apex of the axilla, and in the anterior axillary line. If the procedure is well borne in multilobar involvement, two injections may be made at the same sitting.

With the exception of cough reflex, no definite reaction has been observed to follow whole blood injection. There have been no instances of collapse, syncope, significant pulmonary hemorrhage or pulmonary edema. Two hundred and sixteen blood injections have been given without any evidence of injury or deleterious effect.

The needle employed penetrates the periphery of the viscus from 1 to 4 cm. depending upon the thickness of the chest wall and the presence of pleural thickening or effusion. Injection has been made through effusion in 2 cases without accident. Thoracentesis and aspiration was practised in 2 cases, and in 2 thoracotomy with rib resection was done for empyema. All of these patients recovered. Experience with lung puncture thus employed in pneumonia has not indicated that it encourages the development of empyema or prejudices its successful treatment.

No complications attributable to the procedure have been witnessed. Three

\* Dr. W. E. Deeks, General Manager, Medical Dept. United Fruit Co., has suggested citration of the blood, and the injection of mildly alkaline solutions, or of Ringer's solution.

of nine cases brought to autopsy have revealed from one to three small blood clots in consolidated lung, indicating incomplete distribution of the injected blood before the onset of coagulation. In the remaining six post-mortem examinations no assured evidence that injections had been made could be disclosed in the affected areas.

#### SUPPLEMENTARY TREATMENT

The principals of supportive treatment have emphasized rapid and complete digitalization, administration of fluids by hypodermoclysis in toxic and dehydrated cases (especially important in tropical pneumonia), careful attention to nutrition, avoidance of drastic catharsis, assistance in feeding and in the use of bed pans, and the exhibition of opiates to insure comparative freedom from pain. Oxygen was not employed.

#### ANALYSIS OF CASES

Summaries of the salient features of all cases are contained in the accompanying tables.

Of particular interest is the elapsed time before hospitalization or treatment. It will be seen that this is essentially the same for both groups of cases, a finding at variance with the usual experience. Age of patient appears to have been more directly related to mortality than duration of illness. Of the recovery group, the average age was 24.5 years, while of those who succumbed it was 37.6 years. Of 12 fatal cases, 4 were admitted in grave, and 6 in poor condition, while of 26 who recovered, 2 were considered grave and 9 in poor condition, when first seen. Of the 38 patients 3 were negroes and the rest Central American natives, a race notoriously unresistant to pulmonary infections.

Attention should be directed to the rather large number of complicating diseases displayed on both lists. It should be borne in mind that the average hemoglobin content of natives of the laboring classes of the Guatemalan littoral is seldom over 70%. Only unusually severe degrees of anemia are recorded. In the majority of fatal cases more than one lobe was involved. A further unfavorable factor in the treatment of pneumonia in the American tropics is the fact that a majority of cases are caused by type IV organisms, as shown by Clark.<sup>20</sup>

#### RESULTS OF TREATMENT

Of 38 persons subjected to treatment 12 died, a mortality of 31.5%. Of those who died, one succumbed 24 days after recovery from pneumonia, autopsy revealing both lungs clear, the cause of death being multiple (pneumococcic) abscesses of the kidneys. During the years 1922-1927 the pneumonia mortality of the Guatemala Division averaged 39.9%.

For comparison, in a recent summary of the effect of the administration of refined, concentrated, specific antibody serum (Felton's) under somewhat more advantageous circumstances, Park et al.,<sup>21</sup> report a general mortality rate of

27.5% with serum and 33.2% without serum. Cecil and Sutliff<sup>22</sup> in a similar summary of recent cases in Bellevue Hospital, New York, report a mortality rate

TABLE 1

DIED

No.	Condition on Admission	Age	Sex	Days Sick Before Treatment	Number of Injections	Days in Hospital	Case Number	Comment and Autopsy
1	grave	40	M	7	5	2	58	<i>Autopsy:</i> right and left lower and left upper lobes; ileus
2	grave	35	M	3	4	4	158	Urethral stricture with retention. <i>Autopsy:</i> left lower lobe; pericarditis with effusion, ileus
3	poor	22	M	3	13	11	2352	<i>Autopsy:</i> all 5 lobes in varying stages of consolidation
4	poor	30	M	2	2	4	3088	Lower right lobe; ascaris, uncinaria
5	fair	55	M	6	7	5	2103	<i>Autopsy:</i> right and left lower lobes; hob-nail liver
6	grave	25	F	8	3	2	1962	Complete arrhythmia; gastric dilatation. <i>Autopsy:</i> right lower lobe with one blood clot; plastic peritonitis (pneumococcic) cardiac dilatation
7	grave	29	M	9	3	2	360	Course of quinine and plasmochin at home. <i>Autopsy:</i> right lower and middle lobes, left lower and $\frac{1}{2}$ upper lobes; pyonephrosis (old)
8	poor	32	M	7	5	5	333	Right lower and middle lobes; uncinaria, ascites, edema; RBC 3,010,000, Hb. 25%
9	poor	24	M	6	9	6	409	<i>Autopsy:</i> right upper, middle and lower lobes; left lower lobe; 3 blood clots in left lower lobe
10	fair	42	M	2	6	7	492	<i>Autopsy:</i> right lower and $\frac{1}{2}$ middle lobes; left lower lobe; two blood clots in right lower lobe
11	poor	56	M	16	9	5	716	Negro: course of quinine and plasmochin at home; delirium tremens; right and left lower lobes
12	poor	22	M	9	8	44	3043	Right and left lower lobes; died 24 days after recovery from pneumonia. <i>Autopsy:</i> lungs clear; multiple abscesses both kidneys (pneumococcic)
Averages. . . .		37.6		6.25	6.16	4.8		

of 30.0% in treated cases and 39.2% in untreated cases. The character of the clinical material of the latter series corresponds closely to that of the present paper.



TABLE 2  
RECOVERED

No.	Condition on Admission	Age	Sex	Days Sick Before Treatment	Number of Injections	Case No.	Comment
1	fair	32	F	6	7	706	Left lower lobe; lysis on 6th day
2	fair	30	F	8	4	686	Left lower lobe; crisis after 1st injection
3	fair	50	M	3	3	573	Right lower and middle lobes; lysis on 4th day
4	poor	24	M	10	18	293	Course of quinine at home; right and left lower lobes; spleen +++++; pleural effusion; thoracentesis; Meinkicke +++++
5	poor	18	M	8	14	268	Right upper and lower lobes, empyema, thoracotomy
6	fair	25	M	8	4	452	Left lower lobe; chronic pulmonary tuberculosis; spleen +++++
7	fair	40	M	4	17	372	Right lower lobe; lysis after 12th injection; delirium tremens
8	poor	17	M	7	4	205	Left lower lobe; 1 injection 1% Sodium Citrate in normal saline solution; lysis after 3rd injection
9	fair	50	M	3	6	68	Negro: right lower lobe; crisis after 6th injection
10	fair	29	M	4	5	3210	Right upper and middle lobes; crisis after 4th injection
11	fair	24	M	5	5	3101	Right upper lobe; crisis after 1st injection; relapse on 3rd day
12	good	30	M	8	7	2802	Left upper and lower lobes; crisis after 5th injection
13	fair	34	M	12	1	2549	Left lower lobe; crisis after 1st injection; splenic infarct 19 days later; laparotomy, splenic capsulotomy
14	poor	37	M	4	1	2474	Left lower lobe; crisis after first injection
15	poor	26	M	7	6	2257	Right and left lower lobes; crisis after 7th injection
16	good	24	M	7	5	2238	Left lower lobe; crisis after 5th injection
17	good	25	M	4	6	2264	Right upper, middle and lower lobes; lysis after 1st injection; uncinaria
18	poor	22	M	5	3	2181	Left lower lobe; pseudo crisis after 3rd injection; interlobar empyema diagnosed by Dr. R. C. Connor; thoracotomy
19	good	25	M	8	3	2233	Right lower lobe; lysis after 1st injection
20	fair	27	M	4	1	1791	Right upper lobe; crisis after 1st injection
21	grave	21	M	8	3	1810	Left lower lobe; lysis after 1st injection; algid malaria
22	poor	47	M	12	5	1713	Negro: right lower lobe; lysis after 3rd injection; chronic pulmonary tuberculosis
23	grave	24	M	4	3	1777	Right lower lobe; lysis after 1st injection; compound (machete) fracture of skull; Hb. 55%
24	poor	33	M	15	3	1833	Left upper and lower lobes; lysis after 1st injection; effusion; thoracentesis
25	poor	23	M	9	2	1893	Left lower lobe; lysis after 1st injection
26	fair	20	M	7	5	3086	Right upper lobe; crisis after 5th injection
Averages . .		25.4		6.1	5.4		

## COMMENT

It must be emphasized that a larger number of cases than the series here presented is necessary to properly evaluate any method of treatment.

For this reason no claim can be made in support of the suggested procedure. It is highly significant, however, that injection into consolidated lung can be made without danger. In this manner, solutions of sodium chloride, sodium citrate, mercurochrome, convalescent serum, and pneumococcus antibody solution (Huntoon) have been more recently used by the writer, without untoward effect.

The combined intrapulmonary and intravenous routes probably offer the most effective means of employing specific antibody sera in the treatment of pneumonia.

## SUMMARY

1. Intralobar injections of patient's whole blood has been practised in 38 cases of lobar pneumonia without untoward results, and possibly with benefit.
2. The practicability of intrapulmonary therapeusis by suitable agents has been emphasized.

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## LOBAR PNEUMONIA

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For the past five years, the author has made an annual survey of the number of cases of lobar pneumonia treated during the current year in the hope of discovering (a) some reason for the fluctuation in the total number of cases and in the mortality rate of the cases treated; (b) the influence, if any, of temperature and rainfall, sex, and nativity; and (c) the methods of treatment which had proven to be most effectual. As usual, there were many changes in the personnel of the medical staff and the cases were treated on the services of 6 different physicians.



The average number of persons dependent on the Hospital for treatment was 621 more than 1928. Three cases came from towns whose population is not included in our census; and, of these, 2 cases were cured and 1 died. There was an abnormal decrease in the mortality rate (from 39.37% in 1928 to 19.10% in 1929), which will be mentioned later. There was an increase in the morbidity rate

TABLE 1  
COMPARISON OF MORTALITY RATES

Year	Number of Cases	Number of Deaths	Per cent
1921	31	8	25.80
1922	60	39	65.00
1923	97	52	53.61
1924	101	43	42.59
1925	100	30	30.00
1926	63	23	36.50
1927	55	21	38.18
1928	76	30	39.47
1929	89	17	19.10

TABLE 2  
SEASONAL INCIDENCE

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
Cases . . . . .	10	19	12	11	5	4	2	6	2	9	5	4	89
Deaths . . . . .	0	7	2	2	0	2	0	1	1	1	0	1	17
Per cent . . . . .	0	36.84	16.66	18.18	0	50	0	16.66	50	11.11	0	25	19.10
Av. Rainfall (inches) . .	5.16	2.09	1.05	1.06	6.47	8.54	9.10	5.90	9.42	15.78	8.64	16.84	90.05
Temperature (mean) . .	77	76.5	79	88	85	81	80	80	90	79	79	77	80

TABLE 3  
CASES BY NATIVITY

	Honduras	Salvador	Nicaragua	Jamaica	British Honduras	Cuba	Mexico	Costa Rica	Total
Cases . . . . .	74	8	2	1	1	1	1	1	89
Deaths . . . . .	12	3	0	0	1	0	1	0	17

TABLE 4  
CASES BY SEX

	Male	Female	Total
Cases . . . . .	71	18	89
Deaths . . . . .	15	2	17
Per cent . . . . .	21.12	11.11	19.10

(from 10.20 to 11.46 per thousand); but this was affected by the 3 cases from outside our census area, as well as by the factors which were theoretically responsible for the lower mortality rate.

The total rainfall in 1929 was 7.27 inches more than in 1928. The mean temperature for 1929 was 2.5°F. higher than in 1928. The writer has never been able to demonstrate any relationship between the incidence of lobar pneumonia

and the changes in the seasons of the year which, in this climate, involve only slight variations in the temperature but often marked differences in the quantity of rainfall.

Lobar pneumonia is extremely rare among individuals coming from the temperate zone. That this is due to a certain amount of immunity is assured, as there are a limited number of laborers originally from the temperate zones who are working and living under conditions quite similar to those of the native laborers. Furthermore, many of our European and American employees of the supervising class are exposed to the elements as frequently as the laborers, and exert as much physical effort as the latter, but there have been no cases of lobar pneumonia among this class of employees. In temperate climates it has long been recognized that lobar pneumonia is no respecter of social conditions, and that the millionaire in his brownstone palace is not assured of protection against the disease. Nevertheless, most of the cases encountered in this locality appear among persons who show a lack of personal care and hygiene, who are poorly nourished, and who are invariably suffering from chronic diseases such as malaria, hookworm, and anaemia.

The natives of the respective countries listed in Table 3 are apparently equally susceptible to lobar pneumonia, as the number of cases occurring among the laborers of each nationality are more or less in direct ratio to the number employed.

The mortality rate in 1928 for females was 57.14%, with a total of 22 cases treated. The drop in the mortality rate is striking.

#### COMMENTS

Of the cases treated, 68 were employees and 21 were non-employees.

The patients came from 38 distinct and well separated localities which have practically no contact. The greatest number of cases (17) were from Puerto Castilla, where the largest population is centralized but housing conditions are adequate and permanent, sanitary conditions are good, necessary exposure is least, and access to proper treatment is easiest. The localities where construction and new land work were in progress did not show a high rate of morbidity, although there were large numbers of laborers congregated there and the living conditions were necessarily primitive and crowded.

The average length of time a patient was sick at home and unable to work before coming to the hospital was 6.2 days. Many of the patients had been under the impression that they were suffering from malaria, and had been treated for that condition for several days before admission to the hospital. Five cases were ill only one day before they entered the hospital, and all of these recovered. One case was recorded improperly as lobar pneumonia, as the symptoms and treatment as well as the provisional diagnosis indicated that the patient was suffering from acute pleurisy. Seven cases, all of whom recovered, were obviously classified as lobar pneumonia as the result of incorrect diagnoses. One case of a child,

aged 1½ years, who had been very sick at home for 21 days and died soon after entering the hospital, was either primary or terminal bronchopneumonia.

If the cases mentioned immediately above are deducted from the total, the actual mortality rate is 19.51%.

#### POST-MORTEM FINDINGS

Ten of the fatal cases came to autopsy. In all these instances the extent of the pneumonia had been properly diagnosed, but in 2 cases an encapsulated empyema, as well as other complications which were directly associated with the disease and not remediable, had been overlooked. All 10 cases had multiple lobe involvement, and 6 of them showed an involved area equivalent to more than one complete lung. Malaria complicated but 1 case, and pregnancy and childbirth 1 other. Other complications noted at autopsy were splenitis, pulmonary collapse, uncinariasis, ascariasis, splenomegaly, passive congestion of liver and kidneys, nephrosis, circumscribed necrosis of liver, colitis, *balantidium coli* (1 case), pericarditis, parotitis (1 case), myocarditis, purulent pleuritis (1 case), nephritis, arteriosclerosis, pinta, and cystic degeneration of the ovaries.

#### TREATMENT

No specific method of treatment was followed. Intrapulmonary injection of whole blood<sup>1</sup> was considered but not tried. The potassium permanganate treatment of Nott<sup>2</sup> was used but once, and then unsuccessfully.

Mercurochrome, 1% solution, in doses of 20 to 25 cc., was used in the treatment of 24 cases. In 7 cases it was given from the 10th to the 34th day of hospitalization (presumably with the object of treating unresolved pneumonias), and all of these cases recovered. In 16 cases it was given from the 1st to the 5th day after admission to the Hospital; and, of the patients so treated, 2 died and 14 recovered. One case received doses on the 2nd and 13th day, and recovered. Optochin was administered to 1 case without any marked benefit, although the patient recovered after receiving intravenous injections of mercurochrome on the 34th day, and was discharged the 42nd day.

A large number of drugs were used in symptomatic treatment of the primary condition as well as in the cure of the complications such as malaria and hookworm.

The cases which recovered averaged approximately 19 days of hospitalization, but this included the additional time required for the treatment of complications.

#### CONCLUSIONS

The marked improvement in the mortality rate as compared with that of 1928 cannot be fully explained.

As a rule, the cases came under medical observation at an earlier stage of the disease than in previous years. Less medication was given, but the nursing care



was more attentive. Mercurochrome, as a curative agent for the primary disease was given earlier than previously with a noticeable improvement in the result.

Early hospitalization and prompt diagnosis are essential for the successful treatment of the class of cases encountered in this locality.

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### BERI-BERI AND AVITAMINOSIS

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The present notes are based on the study of 36 cases, which presented all or some of the characteristic symptoms of beri-beri according to the definition of Lt. Col. R. McCarrison of the Pasteur Institute, Cooner, India. These characteristic symptoms are—(1) polyneuritis, (2) cardiac derangement, (3) edema. If all three symptoms are in evidence, the diagnosis is comparatively simple; but, if one of them predominates (as frequently happens), it is necessary to make a guarded diagnosis and to call the condition "Avitaminosis" for want of a better name. It is essential to keep in mind that usually the neuritic symptoms are overstressed, and the important phase of the disease—the pathological visceral derangement—minimized. In some of the patients it was observed that, even after the neuritis had subsided, they still complained of shortness of breath; and enlarged livers and spleens were in evidence.

The etiology of the disease, despite the discovery of the Chiba beri-beri bacillus, is still hypothetical according to many investigators. It is recognized that a diet deficient in water-soluble vitamin B predisposes to the disease; but the writer does not believe that this deficiency is the sole etiological factor, and perhaps further work along the lines pursued by Matsumura and Kato will prove this. In our study of these cases, we investigated their diet and also the locality from which they came and the surrounding sanitary conditions under which they were living; and found that all with the exception of 5 came from one district (No. 1), composed of 5 farms, located near a Cuban town where it was possible to obtain a few green vegetables. Furthermore, the other 5 came from an adjoining district (No. 2). The severe drought of this year, with the subsequent scarcity of

green vegetables and fruits, may be mentioned as a possible predisposing cause to this epidemic; but the remaining districts of the plantation were subjected to the same conditions as the other 2 districts from which these cases originated; and, furthermore, the districts which did not report any cases were farther removed from the town where green vegetables could possibly be obtained. Moreover, in looking back over the Hospital records it was found that every year for the last few years sporadic cases have been admitted from the previously mentioned district (No. 1); and therefore it would appear that beri-beri is endemic in that district.

The diets of these people consisted mainly of rice, beans, and white bread, and occasionally meat. Vegetables were seldom included in their diets, although potatoes and plantains were used at irregular intervals. The beans, before they are cooked, are soaked in water overnight; and the following morning the water is removed and fresh water added, after which the beans are boiled for several hours. That alone is sufficient to destroy a considerable portion if not all of the water-soluble vitamin B that the beans may contain. The rice is highly polished, of cheap quality, and kept long in storage; and shows signs of deterioration as evidenced by the innumerable cobweb-like filaments which mat the grains together, and also by the ease with which some of the grains may be crushed between the fingers. The water, in which the rice is boiled, is discarded. The third article of their diets is white bread, which is almost wholly devoid of vitamins as the result of the super-milling process; so that, as Hoobler points out, the "staff of life must be regarded as but a broken reed."

Considering that vitamin B deficiency was a predisposing factor or bore a symbiotic relationship to some other etiological cause, we advised the planting of green vegetables; and seeds were obtained from the Agricultural Department. The results were most satisfactory, and for two months now there have been no Hospital admissions for beri-beri. Still, the author believes that beri-beri has some other causative factor besides water-soluble vitamin B deficiency. If not, why is it that these cases came almost entirely from one district in the Division; and that the other districts, subjected to the same conditions and identical diets, and further removed from the town where some fresh vegetables were obtainable, did not furnish any cases? The two fatal cases came from places only about 3 kilometers apart.

We have noticed in our cases a prevalent eosinophilia which has led us to believe that there is possibly another etiological factor in beri-beri besides the avitaminosis. The eosinophiles ranged from 3 to 18 per cent. The stools of every patient were examined and, with the exception of 7, were negative for parasites; and, curiously enough, the percentage of eosinophiles in these 7 cases was lower than in the other cases. Skin affections were few (4 cases). The two fatal cases showed 7 and 8 per cent eosinophiles, respectively. Though the eosinophilia may be incidental, we believe it should be further investigated. The hemoglobin content of the red blood cells were normal, as shown by the ratio between the

hemoglobin index and the red blood count; and the white count, as a rule, was normal. One of our fatal cases showed a slight leucocytosis (10,500). Meinicke's test was positive in 3 of our cases; while examinations for malaria parasites were negative in all cases. The urine showed traces of albumin in those patients in which the cardiac symptom were outstanding (Group 1), but was negative in the other cases.

One of our patients was a lactating mother. At the time she applied for treatment, the baby was carefully examined for symptoms of the disease. It was 6 weeks old, and was undernourished; but was apparently free from any beri-beri symptoms. Further investigation had to be discontinued, as the mother could not nurse it and it was put on artificial feeding. Vedder states that, to develop the symptoms of beri-beri, a diet entirely deficient in water-soluble vitamin B must be taken for a period of 90 days—otherwise, if traces of this vitamin are present in the diet, it will take longer for the symptoms to develop. This may account for the absence of symptoms in the infant.

We shall group our cases according to the predominance of the symptoms:

Group I. Cardiac symptoms predominating.

Group II. Polyneuritic symptoms predominating.

Group III. Edematous symptoms predominating.

Group IV. Symptoms equally in evidence.

Group V. Cases not presenting clearly defined symptoms of the disease.

#### GROUP I—2 CASES

##### CASE NO. 1

M. P., Cuban, male, age 25 years, was admitted Sept. 23, 1929, with history of numbness of the legs and hands, anorexia, weakness, and malaise; and for the preceding few days had suffered from dyspnea, vomiting, and pain in the epigastrium.

His usual diet consisted of rice, beans, and bread, and occasionally meat. He had always enjoyed good health.

*Physical Examination.*—The patient seemed to be fairly well nourished; but exhibited the following pathological conditions: dental caries; on percussion, right heart appeared enlarged; muscular sounds, weak; abdomen, flaccid; liver and spleen, enlarged; tenderness over the epigastrium, but no muscular rigidity; muscles of extremities appeared soft and without tone; double wrist drop; no tactile sense of fingers or inner side of legs; tenderness of gastrocnemius muscles on pressure. The knee-jerk reaction was absent, but the Achilles and Babinski reflexes were negative.

*Laboratory Findings.*—The laboratory examination showed: Meinicke test, negative; urine, trace of albumin; eosinophilia, 7 per cent.

*Comment.*—During the entire time the patient was in the Hospital the temperature was normal, except for a few hours before death. He died Sept. 27, 1929. The autopsy findings in the two cases included in this group appear below, at the conclusion of the remarks concerning Case No. 2.



CASE No. 2

F. H., Cuban, male, age 25 years, was admitted Oct. 2, 1929. Six weeks previously he had noted numbness of the lower extremities extending to the knees, and of the hands and forearms of the upper extremities. One week before admission he could not walk; and during the few days immediately preceding hospitalization he had suffered from anorexia and shortness of breath, and had felt weak. At the time that he entered the Hospital he was having spells of vomiting and experiencing epigastric pains. His usual diet was quite similar to that of the patient indicated as Case No. 1 of this Group.

*Physical Examination.*—The patient's temperature was subnormal. He appeared to be well nourished, but exhibited the following pathological conditions: mucous membranes, pale; orthopnea; dental caries; heart, increased in size and sounds were poor; pulse, weak and rapid; lungs showed fluid at the posterior bases; abdomen, flaccid; liver, enlarged; spleen, palpable; tenderness over epigastrium, no muscular rigidity; no tactile sensation in fingers; lower extremities, swollen; gastrocnemial region, tender on pressure and muscles, flabby; no tactile sensation in anterior and medial aspect of legs; knee-jerk reflex, absent; Achilles and Babinski reflexes, negative.

*Laboratory Findings.*—The laboratory examination showed: urine, trace of albumin; slight leucocytosis; 8 per cent eosinophiles; stool, negative for intestinal parasites; Meinicke test, negative.

*Comments.*—The patient died on October 3, 1929.

*Autopsy Findings.*—The autopsy findings in the two cases included in this group were almost identical, as will be seen by referring to the data appearing below:

	CASE No. 1	CASE No. 2
<i>Heart.</i> —	Hypertrophied; dilated right heart; pale, flabby muscle; no valvular disease.	Hypertrophied; dilated right heart; pale, flabby muscle; no valvular disease.
<i>Lungs.</i> —	Hyperemic; edema of base.	Hyperemic; slight edema of base.
<i>Hydropericardium.</i> —	Present.	Present.
<i>Spleen.</i> —	Hypertrophic; violaceous color.	Hypertrophic; pale color.
<i>Pancreas.</i> —	Apparently normal.	Apparently normal.
<i>Liver.</i> —	Congested; enlarged.	Congested; enlarged.
<i>Stomach.</i> —	Hyperemic.	Hyperemic.
<i>Ascites.</i> —	No.	Present (slight).
<i>Kidneys.</i> —	Enlarged; congested; capsule stripped easily.	Enlarged; capsule stripped easily.
<i>Muscles.</i> —	Pale; atrophic.	Pale; atrophic.

GROUP II—19 CASES

*History.*—All the patients included in this group gave a somewhat similar history. The typical history may be described as follows: a general feeling of weakness and anorexia had persisted for several weeks; in the initial stages the patient

was conscious of a tingling sensation in the fingers and toes, and subsequently numbness developed gradually in the arms, and in the legs to such an extent that eventually the victim could not walk; the gastrocnemius muscle was painful on pressure; and pain was felt in the epigastrium. In most cases, there was no vomiting.

*Physical Examination.*—The patients appeared fairly well nourished. The temperature was subnormal. The other physical findings may be briefly summarized as follows: dental caries and pyorrhea alveolaris, usually present; mucous membranes, pale; chest and abdomen, negative; gastrocnemius regions and around knees exhibited tenderness on pressure; the medial aspect of the leg, the fingers, and sometimes the forearms, showed a diminution or absence of tactile sense. The knee-jerk reaction was absent; the Achilles reflex, usually absent; and the Babinski reflex, negative.

*Laboratory Findings.*—The laboratory findings were: urine and stool, negative; blood, negative for malaria parasites; eosinophilia; red blood-count, around 3,000,000; hemoglobin, about 70 per cent; Meinicke test, negative in most instances, but positive in 2 cases.

*Special Comments on Two Cases of Group II.*—In this group there were 2 cases of the dry beri-beri type, and both were paraplegic. The physical findings in these 2 patients were somewhat similar—i.e., chest and abdomen were negative; tactile sensations were absent in the extremities; wrist-drop, bilateral in one (female); marked tenderness on pressure of calf muscles. One of these patients (male) showed an eosinophilia of 18%. In both cases, the stool was negative and the skin was normal. Each patient remained in the Hospital for 75 days; and, as the condition was very much improved, was then discharged with the understanding that they would continue to follow the dietetic rules observed while they were in the Hospital and would report to the Clinic at frequent intervals for further examination and medical advice.

#### GROUP III—1 CASE

Only one case of this variety was observed (Fig. 1). This patient's history was almost identical with the "typical history" described under Group II. He had lived on a poorly balanced diet; and had suffered from general weakness, anorexia, inability to walk; and pain in the epigastrium. He appeared pale and anasarous; and symptoms of ascites were present. At the time of admission, the eosinophilia was 7%; red blood-count, 4,200,000; hemoglobin, 75%; temperature, subnormal. Urine and stool examinations made at intervals during the period of hospitalization were invariably negative. The patient made a very good recovery; and left the Hospital on the 70th day, as his general appearance was practically normal and the anasarca had subsided.

## GROUP IV—6 CASES

This Group includes cases in which edema of the lower extremities and swelling of the face, as well as the polyneuritic signs, were present. No anasarca

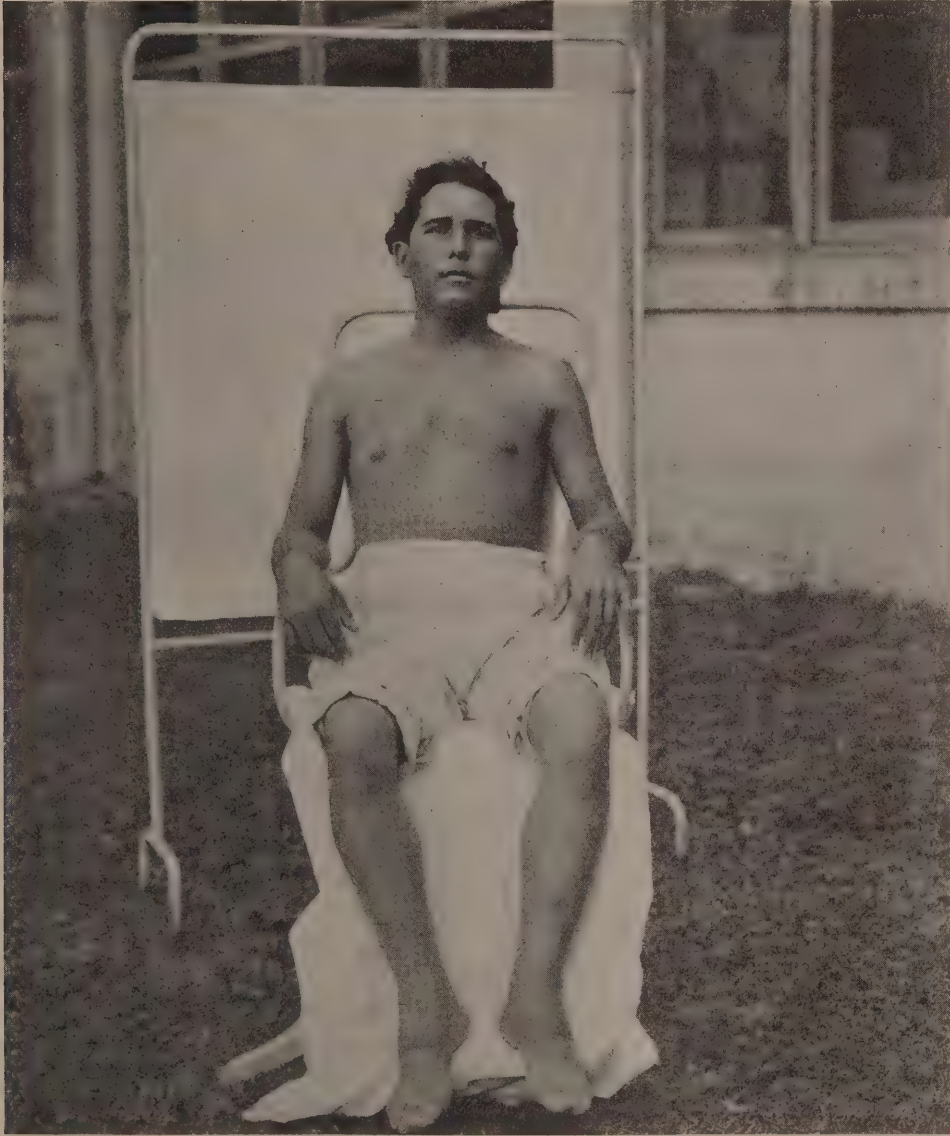


FIG. 1

developed. The history, and the symptoms other than those specifically mentioned above, correspond closely with those observed in the patients included in Group II.



## GROUP V—7 CASES

*History and Physical Examination.*—The routine diet of the patients included in this Group was similar to that of the other patients referred to in this paper; but their symptoms were relatively slight, and did not necessitate hospitalization. They complained of anorexia, pain in the epigastrium, and numbness of the hands and legs; but were able to walk well, although easily exhausted. The physical examinations showed some swelling of the ankles and face; but there was no marked tenderness of the gastrocnemii muscles, and only 3 exhibited tactile changes in the legs. The knee-jerk reflexes showed no uniformity—i.e., in some cases it was increased; in some, diminished; and in one, absent.

*Laboratory Findings.*—Urine and stool examinations, and the Meinicke test, were negative. Four showed eosinophilia, between 3 and 4 per cent.

## GENERAL COMMENTS

All of these patients gave typical histories of unbalanced diets, stating that the severe drought had resulted in a dearth of fresh fruits and vegetables. They all came from two closely adjoining districts, although similar living conditions prevailed in the entire Division. Fever was a negligible symptom, as it occurred in only 2 cases and in these instances the temperature became normal within a few days. The wet variety occurred in 1 case; and 2 patients exhibited paraplegic forms of the disease.

*Treatment.*—The treatment was mainly dietetic. They were given generous quantities of fresh fruits and vegetables; limited amounts of meat and beans; and wholewheat bread and liver, whenever these were obtainable. Rice and other acid-ash foods in the form of refined cereal carbohydrates were eliminated from the diet. Yeast was given to a few cases, with indifferent results. Massage and passive movements were helpful; and particularly in the paraplegic types. Pink Tonic Tablets were given to most of the patients; but drugs were administered more for the psychic effect than for their curative properties, although *nux vomica* seemed to have some physiological value in the treatment of cases of the paraplegic form. The author had little experience with the magnesium sulphate treatment recommended by some Japanese writers, as in most cases he considered that it was contraindicated.

*Results.*—Most of the hospitalized patients remained in the Hospital until they had apparently recovered from the condition and it was considered that they could and would follow the routine diets prescribed; but some of them were discharged while still under treatment, and requested to come to the Clinic at regular intervals—which they invariably did. All patients were given strict instructions concerning the regulation of their diets; and Farm Superintendents were impressed with the necessity of planting sufficient fruit trees and vegetables to provide an adequate supply of such food-stuffs for their laborers.

## SUMMARY

1. Most of the cases (31) came from one district, and the other 5 cases were from an adjoining district. The economic and sanitary conditions as well as the dietary regimen, in those localities were exactly similar to those existing in the other districts of the Division.

2. All of the patients were Cubans, with the exception of one Chinaman and one Spaniard.

3. Eosinophilia was found in most cases; and, at the time of admission, ranged from 3% to 18%, with an average of 7%. Stools were negative for parasites in 32 cases—the other 4 cases showed uncinaria ova; and their eosinophilic counts were unusually low (3 to 4%). Skin conditions were rare (2 cases). We hope to be able to compare eosinophilic findings in future cases. The last eosinophilic count previous to discharge showed that in almost all cases it had greatly diminished during the period of treatment. One case showed 18% eosinophilia on admission, and 6% eosinophilia when discharged 76 days later.

4. The wet beri-beri variety was rare (1 case).

5. The paraplegic form was found in 2 cases.

6. The polyneuritic form was found in most cases.

7. Cardiac symptoms predominated in 2 cases, and both proved fatal.

8. The author believes that beri-beri has some other etiological factor in addition to avitaminosis.

## APPENDICITIS AND DIET

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Appendicitis and the aetiological factors responsible for the condition have received considerable attention in the medical literature. The present paper is not written for the purpose of describing a new or unusual form of the disease, but to record certain specific characteristics appearing in 10 cases treated in the Banes Hospital during the past 2 years.

The patient is usually a woman of the chloro-anemic type described by Dieulafoy, and is suffering from chronic constipation and copremia. She will give a history of repeated attacks of pain in the lower abdomen; which are sometimes very severe and on other occasions are very mild, and are not accompanied by vomiting or fever. The attacks never last more than a day, and usually subside within a few hours; and the following day it has disappeared entirely, or there is merely a slight tenderness in the region. The patient will seek medical treatment during the course of one of the severe attacks; and palpation of the abdo-

men will reveal a marked pain or tenderness over McBurney's point, although no muscular rigidity is perceptible and the temperature is normal. A diagnosis of chronic appendicitis is made, and an operation is recommended. The white blood-count is about normal or slightly above normal, and is not alarmingly increased as in an acute case.

It will be determined that the patient has lived on an unbalanced diet, in which the intake of carbohydrates is very high; that fruit and fresh vegetables are seldom eaten; and that bread and candy are taken in excessive quantities. Chronic constipation has existed for a considerable period of time, and, at intervals, 3 or more days will have passed without defecation. When the abdomen is palpated, the descending colon is ascertained to be full of a very hard fecal matter. The teeth are carious, and the gums are inflamed. The anterior pillars of the throat are very red and almost congested, and the pharynx shows chronic granulations. (This is the typical "carbohydrate-throat" described by Deeks.)

In some instances an emergency operation has been performed, with the expectation of finding a very severe gangrenous appendix. In other instances, the patient has declined to submit to an operation when it was first suggested; the symptoms disappeared; and she felt well until the next acute attack, when she decided to undergo an operation.

When the abdomen is opened and the appendix exposed, the surgeon is surprised to find the latter almost normal, without adhesions or congestions but with a few small dilated vessels running through its body. In view of the apparent lack of sufficient abnormality in the appendix to account for the severe pain experienced by the patient, the ovaries and gall-bladder are explored without positive findings. Returning to the appendix, it is found on palpating it that there is a fecalith in its lumen, which is readily movable and can be pressed backwards and forwards between the cecum and the appendix.

In one case, 6 fecaliths were found and the appendix resembled a small sackful of shot. The appendix is otherwise macroscopically normal; and, although it may be slightly enlarged in some instances, there is no sign of acute or chronic inflammation. After the operation, the patients cease to complain of pain in the abdomen.

It is generally taught that the appendix only retains the longitudinal layer; that the circular muscular layer of the cecum ends at its base, forming a kind of sphincter; and that the mucous membranes form a valve at its base (*Gerlach*). However, in these cases it has been found that the lumen communicates freely with the cavity of the cecum. It is the opinion of the author, that these cases can develop into acute, severe conditions by a process of appendicitis obliterans; and may result in a ruptured appendix with the subsequent formation of an appendiceal abscess, or in general peritonitis.

The author, in presenting these cases, desires to draw attention particularly to (a) unbalanced diets as the probable etiological factor, (b) the presence of



chronic constipation in all instances; and (c) the movable fecaliths found in the lumen of the appendix.

A diagnosis of "*Social Appendicitis*" is made, and the patients are usually discharged after a short and uneventful convalescence. The fact is, however, that such patients will not suffer from abdominal pains after their faulty diet is corrected.

In reviewing the literature on the subject, the writer has observed that some authors seem to confirm his opinion concerning the importance of diet as an etiological factor in appendicitis.

John A. Lichty, in discussing the etiology of appendicitis, says: "*This diet is characterized by an excessive carbohydrate content. Much more sugar and carbohydrates in general are consumed per capita at present than in former years.*"

Doctor Weinberg\* stated: "*No observations in recent years throw more light on the cause of appendicitis than those made on chimpanzees dying in captivity. We have seen that the cecum and appendix have the same form in chimpanzee as in man. In 10 out of 61 chimpanzees, appendicitis was found at death. We have no reason to suppose that in its natural habitat, this anthropoid is specially liable to appendicitis—the evidence is purely negative; but as soon as the chimpanzee comes into captivity and is placed on a human diet and exposed to human contagion, it becomes subject to a prevalent human disease. In chimpanzee, we blame the diet.*"

## UNERUPTED WISDOM TOOTH WITH DECAY

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It is now recognized by students of nutrition that the factors which predispose to dental decay do not rest in the unhygienic oral conditions, but in diets deficient in certain essential food factors. The most important of these are vitamins D, A and C; and mineral salts, calcium, phosphorus, and probably to a lesser extent others also.



\* Bull. de la Soc. de Path., November 1908, p. 556.

The accompanying skiagraph is of an unerupted wisdom tooth, kindly furnished by Dr. D. F. Reeder of Panama. It shows decay; and the condition obviously could not be due to oral uncleanness nor to bacterial invasion of the oral mucosa which was unbroken. Dr. Reeder stated that all the remaining teeth exhibited evidence of dental decay, and that the patient gave a dietetic history of having lived mainly on meat, bread and potatoes, none of which possesses adequate quantities for protection of vitamins A and D, nor of calcium.

## SOME CLINICAL ASPECTS OF DEFICIENT DIETS

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It is not the intention of the author to enter into an exhaustive discussion on the subject of diet. It is his desire to merely report a few cases treated in the Clinic of the Banes Hospital, whose clinical picture and blood findings before and after a simple change in their dietaries, without the use of any medication whatsoever, seem to confirm the present views of the ill effects caused in the organism by the excessive consumption of carbohydrate foods in the form of *refined* sugars and cereals, and starches, associated with the consequent absence of sufficient vitamins and alkaline inorganic salts in the food intake.

### CASE REPORTS

CASE 1.—A. C., Cuban, male, 18 years of age, came to the Clinic on Oct. 24, 1929.

*History.*—He complained chiefly of spermatorrhea, headaches and anorexia, and skin eruptions on both feet during the preceding 3 months.

*Physical Examination.*—The patient was robust and well-built. The principal symptoms recorded were a coated tongue, chronic pharyngitis, decayed molars, bleeding gums, slight conjunctivitis, acne of the face, and eczematous eruption on both feet. The heart, lungs, and abdomen were negative.

*Usual Diet.*—His routine diet consisted mainly of rice and sweets; with very small amounts of bread and meats, and no green vegetables or fresh fruits.

*Treatment.*—He was instructed to live on a well-balanced diet, and to return for reëxamination in a month or two. No medication was prescribed.

*Results.*—On Dec. 14, which was 51 days after the first consultation, the patient reported again at the Clinic. The decayed molars had been removed, and all other symptoms had disappeared.

*Laboratory Findings.*—Oct. 24th, at the time of the first consultation—red blood-count, 2,900,000; hemoglobin, 60%.

Dec. 14th, after 51 days of dietetic treatment—red blood-count, 4,636,000; hemoglobin, 75%.

CASE 2.—F. B., Cuban, male, 18 years of age, visited the Clinic on Oct. 27, 1929.

*History.*—He stated that he suffered from chronic constipation; and that, during the preceding 8 days, he had had a pain in his back and a tired feeling on exertion.

*Physical Examination.*—The patient was a well-built, young, male adult; and apparently well-nourished. The principal symptoms were dry, falling hair, acne of the face, chronic pharyngitis, bleeding gums, 3 decayed lower molars, a red-dish tongue, tachycardia, and absence of patellar reflexes. The lungs and abdomen were negative.

*Usual Diet.*—His routine diet consisted of an excessive quantity of rice, sweets and bread; with meat, eggs and fish occasionally, and no green vegetables or fresh fruits.

*Treatment.*—No medication was prescribed, but he was instructed to follow a well-balanced diet.

*Results.*—He reported at the Clinic on Nov. 8th, and again on Nov. 17th; and, on both occasions, asserted that he felt well and was not constipated.

*Laboratory Findings.*—Oct. 27th—red blood-count, 3,244,000; hemoglobin, 55%.

Nov. 8th—red blood-count, 3,780,000; hemoglobin, 60%.

Nov. 17th—red blood-count, 3,712,000; hemoglobin, 65%.

CASE 3.—F. T., Cuban, female, 15 years of age, called at the Clinic on Oct. 26, 1929.

*History.*—The patient stated that, for the preceding 6 months, she had suffered with headaches, dysmenorrhea, constipation, and a chronic eczematous condition on both feet; and that she had been treated with various medications which gave her temporary relief only.

*Physical Examination.*—She was poorly nourished. The principal symptoms were eczema of both feet, inguinal adenitis, coated tongue, decayed molars, hypertrophied tonsils, and chronic pharyngitis. The heart, lungs, and abdomen were negative.

*Usual Diet.*—Her routine diet consisted principally of sweets, rice, and bread.

*Treatment.*—No medication was prescribed, but the patient was instructed to follow a well-balanced diet.

*Results.*—She reported to the Clinic on Nov. 9th, Dec. 17th, and Dec. 27th; and asserted each time that she had enjoyed good health during the intervals.

*Laboratory Findings.*—Oct. 26th—red blood-count, 3,612,000; hemoglobin, 64%.

Nov. 9th—red blood-count, 3,980,000; hemoglobin, 70%.

Dec. 17th—red blood-count, 3,998,000; hemoglobin, 70%.

Dec. 27th—red blood-count, 3,997,000; hemoglobin, 75%.



CASE 4.—A. R., male, Cuban, 42 years of age, visited the Clinic on Oct. 27, 1929.

*History.*—For the preceding 4 months, he had been feeling weak and suffered from headaches, anorexia, constipation, and swelling of the legs.

*Physical Examination.*—The patient was a well-built but poorly nourished male adult. The principal symptoms were a heavily coated tongue, intense pharyngitis, palpable inguinal glands, and edema of the ankles. His pulse was weak and very rapid, but no heart murmurs were perceptible. The lungs and abdomen were negative.

*Usual Diet.*—His routine diet consisted of rice, sweets, bread, and meat; and included no green vegetables or fresh fruits.

*Treatment.*—No medication was prescribed, but the patient was instructed to follow a well-balanced diet.

*Results.*—The patient reported to the Clinic on Nov. 17th, and again on Dec. 22nd; and asserted that his physical condition was greatly improved.

*Laboratory Findings.*—Oct. 27th—red blood-count, 2,192,000; hemoglobin, 47%; urine: specific gravity 1.018, with acid reaction but otherwise negative.

Nov. 17th—red blood-count, 3,040,000; hemoglobin, 60%.

Dec. 22nd—red blood-count, 3,065,000; hemoglobin, 75%.

CASE 5.—A. S., female, Cuban, 40 years of age, visited the Clinic on Oct. 30, 1929.

*History.*—Her immediate complaint was pain in the stomach and cramps in both hands; but she stated that she had had a general feeling of lassitude for the preceding 5 months, and had taken several patent medicines without results.

*Physical Examination.*—The patient was a well-built female adult, who was apparently well-nourished. The principal symptoms were a heavily coated tongue, red and enlarged tonsils, and chronic pharyngitis. The heart, lungs, and abdomen were negative.

*Usual Diet.*—Her diet consisted mainly of rice and bread, although it occasionally included meats and other foodstuffs.

*Treatment.*—No medication was prescribed, but the patient was instructed to follow a well-balanced diet.

*Results.*—The patient reported to the Clinic on Nov. 16th and Dec. 17th, and asserted that her symptoms had disappeared and she was feeling very well.

*Laboratory Findings.*—Oct. 30th —red blood-count, 2,764,000; hemoglobin, 60%.

Nov. 16th—red blood-count, 4,264,000; hemoglobin, 70%.

Dec. 17th—red blood-count, 4,056,000; hemoglobin, 75%.

CASE 6.—A. A., male, Cuban, 36 years of age, visited the Clinic on Oct. 29, 1929.

*History.*—He complained of headache, neuralgic pains in various parts of his body, and dizziness.

*Physical Examination.*—The patient was a robust, adult male, who was apparently well-nourished. The principal symptoms were dry hair, abnormally reddish tongue, two decayed upper incisors, and pharyngitis. The heart, lungs, and abdomen were negative.

*Usual Diet.*—His routine diet consisted of rice and sweets; with meat and bread occasionally, but no green vegetables or fresh fruits.

*Treatment.*—No medication was prescribed, but the patient was instructed to follow a well-balanced diet.

*Results.*—He reported to the Clinic on Nov. 6th and 20th, and stated, on both occasions, that he was feeling very well.

*Laboratory Findings.*—Oct. 29th—red blood-count, 3,220,000; hemoglobin, 60%.

Nov. 6th—red blood-count, 4,124,000; hemoglobin, 70%.

Nov. 20th—red blood-count, 4,224,000; hemoglobin, 80%.

CASE 7.—N. M., male, Cuban, 42 years of age, visited the Clinic on Nov. 13, 1929.

*History.*—He complained of pains in the joints, mucous diarrhea, anorexia, facial neuralgia, and general feeling of lassitude.

*Physical Examination.*—The patient was a poorly nourished male adult. The principal symptoms were pyorrhoea alveolaris, coated tongue, chronic pharyngitis, eczematoid condition on both feet, tachycardia and diminished heart sounds. The lungs and abdomen were negative.

*Usual Diet.*—His routine diet consisted of an excessive proportion of rice and bread, although he usually had meat, fish, or eggs once a day. He asserted that he never ate sweets, green vegetables, or fresh fruits.

*Treatment.*—No medication was prescribed, but the patient was instructed to follow a well-balanced diet.

*Results.*—He reported to the Clinic on Dec. 7th and Dec. 30th, and his condition showed marked improvement.

*Laboratory Findings.*—Nov. 13th—red blood-count, 2,860,000; hemoglobin, 55%.

Dec. 7th—red blood-count, 2,889,000; hemoglobin, 60%.

Dec. 30th—red blood-count, 3,816,000; hemoglobin, 65%.

CASE 8.—F. O., female, Cuban, 14 years of age, visited the Clinic on Oct. 30, 1929.

*History.*—The patient suffered from constipation, pyrosis, headaches, dysmenorrhea, leucorrhea, and mucous diarrheas occasionally. Her appetite was erratic.

*Physical Examination.*—She was apparently a well-nourished young female adult. The principal symptoms were dry hair, decayed upper and lower teeth, chronic pharyngitis, abnormal redness of the tongue, acutely inflamed tonsils, and tenderness of the abdomen. The heart and lungs were negative.

*Usual Diet.*—An investigation of her routine diet revealed that she ate an excessive amount of bread and brown-sugar sandwiches; while she never took green vegetables or fresh fruits, and meat only occasionally.

*Treatment.*—No medication was prescribed, but the patient was instructed to follow a well-balanced diet.

*Results.*—She reported to the Clinic on Nov. 15th and Dec. 6, 1929, and on Jan. 20, 1930; and stated each time that she was feeling very well.

*Laboratory Findings.*—Oct. 30th—red blood-count, 3,422,000; hemoglobin, 65%.

Nov. 15th—red blood-count, 3,652,000; hemoglobin, 70%.

Dec. 6th—red blood-count, 4,288,000; hemoglobin, 70%.

Jan. 20th—red blood-count, 4,355,000; hemoglobin, 75%.

#### SUMMARY

The special feature of these 8 cases, which is considered of particular interest, was the striking changes observed in the red blood-count and the hemoglobin, within a short period of time. When the patients first returned to the Clinic to report that they had observed the diet rules prescribed and to submit to re-examination, marked improvements were invariably shown. The blood examinations were made by the Laboratory Technician in the Hospital, who was not acquainted with the nature of the cases nor aware that they were of special interest to the clinician. The findings reported were abstracted from the records made in the laboratory book at the time of the respective examinations.

It is obvious that the conditions of these patients were primarily caused (a) by the excessive consumption of some of the acid-ash foods (such as refined cereals), and sugars; and (b) by the lack of sufficient vitamins and alkaline inorganic salts, due to the fact that their diets did not include tubers, beans, peas, leafy green vegetables, fresh fruits, etc., from which such elements are derived. Polished rice, white bread, and sweets were undoubtedly the classes of carbohydrates eaten in excess by these patients, as the average Cuban seldom consumes any other kinds of refined foods.

The diet prescribed in these cases prohibited the use of rice, bread and all forms of sugars; advised the use of meats, eggs and fish in moderation; and insisted upon an abundant consumption of vegetables, fresh fruits, and milk.

The symptoms recorded seem to have been early manifestations of inadequate diets; which, if they had not been properly changed in time, would have led to more serious organic deteriorations at a later date.



## NOTE UPON EPIDERMOMYCOSIS OF THE FEET

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The rebellious resistance to treatment of many of the chronic forms of ring-worm infection of the feet has become a byword among dermatologists. Pusey,<sup>1</sup> for example, asserts that the "results of treatment of the chronic condition are not nearly so definite and prompt as those of the acute condition;" while Legge, et al.,<sup>2</sup> in a preliminary report of the most extensive investigation of this disease yet undertaken, state that Whitfield's ointment (modifications of which are the basis of most forms of treatment) has, in their experience, proven "far from satisfactory."

*Treatment with Ethyl Chloride Spray.*—The writer has been prompted to publish a brief note upon epidermomycosis of the feet, because of his personal experience with this infection, and the apparent success of the method of treatment used upon himself and a limited number of other cases (6). Witnessing the uncertain results from standard methods of treatment in his own case (it must be admitted that intensity and regularity were at times lacking), the writer repeatedly froze his own digital and plantar lesions with ethyl chloride spray. The response surpassed anticipation. Recurrences, treated in a similar manner in their earliest stages, were even more promptly subdued.

To be effective, freezing should produce blanching of the skin (including the lesion itself) for a distance of at least 0.5 cm. beyond the periphery of the affected area; and blanching should be sustained for from  $\frac{1}{2}$  to 1 minute. In most cases, one complete daily freezing of all lesions will suffice. Where the epidermis is thick, as in the plantar region, it may be advisable to apply the treatment twice daily; and from 2 to 6 or more applications of the spray may be required to secure subsidence of the infection. For control purposes, no other therapeutic agents have been employed excepting in cases complicated by acute eczematous dermatitis or pyogenic infection. Plantar lesions are covered with a small square of gauze and adhesive plaster dressing between treatments, but digital and interdigital lesions are usually left unprotected. The customary precautions to prevent reinfection are advocated. Loose skin edges and over-hanging margins of epidermis are trimmed away, in order to render more effective the action of freezing upon the organisms.

*Contraindications to Ethyl Chloride Treatment.*—Relative contraindications to ethyl chloride treatment are, acute eczematous dermatitis (scaly, fissured, or oozing); and acute inflammation, whether of recent lesions, or due to pyogenic infection of those of longer duration. Chronic eczematoid conditions due to irritation arising from the long continued presence of mycotic fungi, may be

cautiously treated with the ethyl chloride spray; but its application should be interrupted at the first evidence of acute local reaction.

*Further Experimentation Recommended.*—As only a few cases have been treated by this method, the proof of its value has not been fully demonstrated; and the writer would appreciate its trial by other Company physicians.

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### PRELIMINARY STUDIES OF SYPHILIS OF THE CENTRAL NERVOUS SYSTEM AND ITS RATIONAL THERAPY IN A MALARIA-INFESTED POPULATION

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The frequency of the diagnosis, "*Syphilis of the Central Nervous System*" in the colored population admitted to the Company Hospitals, depends largely upon the number of spinal fluid determinations in our laboratories. Though there is little doubt that the genuine metaluetic diseases such as general paresis and tabes dorsalis are rarely met with in the negro of these regions, I believe cerebrospinal syphilis to be much more frequent than is generally supposed. In fact, the clinical picture these patients offer is so protean, and the symptoms from which they complain are so vague, that only the laboratory tests reveal their true nature.

In the Almirante Hospital from January to July, 1929, I found that among 53 cases with definite central or peripheral nervous symptoms there were 20 cases of cerebrospinal syphilis, one case of general paralysis and one case of taboparalysis. During that time they comprised about 10 per cent of all the cases admitted to the Hospital with syphilis as a primary diagnosis or in association with some other diseases (outpatient clinic cases of lues not being included).

Besides the usual spinal fluid tests such as the Meinicke Turbidity Reaction and the Wassermann reactions, cell count, and globulin test, we applied during the past year a little known test—the "Acetic Acid Sulphuric Acid Test" (hereinafter referred to as the "Boltz's test")—which is very easily readable and simple to perform. It will be described later.

## TREATMENT OF CEREBROSPINAL SYPHILIS

The treatment of the late manifestations of syphilis is still one of the most debated problems of syphilis therapy. In early cases, with the exception of those who show an idiosyncrasy for the usual remedies, there is very little danger connected with the treatment as long as we keep within the known therapeutic limitations. Old neglected or insufficiently treated cases demand much more individual attention in order to avoid untoward effects. This holds true, especially, for the late luetic manifestations of the central nervous system in our colored populations who seldom have had any intensive treatment previously.

The administration of salvarsan to such cases is often followed not only by disagreeable and dangerous circulatory complications but also by untoward manifestations in the central nervous system. Mercury is often not well tolerated, although potassium iodide and bismuth usually give very satisfactory results—none of which, however, are able to keep the progress of the disease under control unless they are given over a very long period of time.

The excellent results which have been obtained with malaria therapy in neurosyphilis induced me to try it in some of my cases. I reported last year (Annual Report of 1928) the difficulty of producing febrile reactions in these cases. The therapeutic results were accordingly very unsatisfactory.

Among other foreign proteins, typhoid vaccine has been successfully used in various diseases in order to produce a thermic shock for therapeutical reasons.

Since February, 1929,\* I have treated 11 cases of neurosyphilis by combining intramuscular injections of bismuth salicylate and the oral administration of potassium iodide with intravenous injections of a mixed typhoid-paratyphoid vaccine in increasing doses.

The first 8 cases, all West Indian negroes, were treated at the Almirante Hospital (Panama). The others were in Santa Marta Hospital (Colombia), consisting of 1 white and 2 colored Latin-Americans.

## CASE REPORTS

(Almirante Hospital, Panama)

CASE No. 1.—Male negro, age 58 years.

*Diagnosis.*—General paresis associated with aneurysm of the ascending aorta.

*History.*—1927, M.T.R. + + + in blood, was treated with potassium iodide and neosalvarsan, 5 injections, total amount 4.2 grams. During the past few weeks (2 years after treatment) he was mentally disturbed; and he had been drinking heavily recently.

*Symptoms.*—Ataxic speech; increased knee jerks; sluggish unequal pupils;

\* The Journal of the American Medical Association, Vol. 92, No. 11, March 16, 1929, in an abstract from the Archives de Médecine, Chirurgia y Espec., Madrid, Dec. 29, 1928, mentions one case of paresis treated by B. Lois, in which he obtained good results by combining injections of sodium bismuth tartrate solution with Nicolle's vaccine. When I started my series in February, 1929, this case had not yet come to my knowledge.



delusions of grandeur. He was making speeches while standing on his bed; was very restless, and became violent when interrupted.

*Laboratory Reports.*—M.T.R., in blood and spinal fluid, positive; Boltz's test, positive.

*Treatment.*—In January, 1929, malaria transmission by mosquito inoculation was tried by Dr. Barber and Mr. Komp, with a negative result. In February, combined specific and non-specific treatment was started. He received 6 typhoid-paratyphoid vaccine injections intravenously (total amount 1,600 millions bacteria), 12 bismuth injections, and 75 grains of potassium iodide daily for over 13 weeks.

*Result.*—Complete recovery—both mentally and physically. The patient's weight increased 7 pounds during the treatment; and he has been working for the past 8 months as a steady reliable man in the Exportation Department.

*Remarks.*—The patient was very restless during the first weeks of treatment, during which time he developed aphonia which still persists and was found to be due to recurrent laryngeal nerve paresis. An X-Ray picture of the chest revealed a large aneurysm of the ascending aorta. Notwithstanding this condition, the fever paroxysms from the vaccine were well tolerated.

CASE No. 2.—Male negro, age 53 years.

*Diagnosis.*—Taboparalysis, associated with aortitis luetica.

*History.*—The patient was admitted to the Hospital in October, 1928, for syphilitic aortitis; and received, during his 10 days stay, 2 bismuth injections and potassium iodide. Eight days later he received, against my wishes, in the outpatient clinic, 0.6 gram neosalvarsan. He did not return for further treatment.

*Symptoms.*—In January, 1929, (4 months later) he returned to the Hospital with some fever; and his blood showed malaria parasites. He could not walk; and even standing was difficult. His speech was disturbed, and he showed complete absence of knee jerks. His Romberg was strongly positive, and he had ataxia of both arms and legs. Paraesthesia of the hands and feet were present, with disturbed thermic sensibility of the skin. The pupils were very sluggish; there was incontinence of urine and faeces; and he suffered from severe headache and slight dementia.

*Laboratory Reports.*—M.T.R. +++ in blood; M.T.R. in spinal fluid ++; globulin test, positive; and cell count 70 per cu. mm.

*Treatment.*—Fifteen days after admission malaria infection by mosquito was attempted by Dr. Barber and Mr. Komp without success. (The patient had been treated for his original malaria infection from the day of his admission, and his blood had become negative after 2 days.) Four weeks after admission, specific and nonspecific treatment was started. He received 8 intravenous typhoid-paratyphoid vaccine injections (total amount 3,500 millions), 8 bismuth injections, and 60 grains of potassium iodide daily over a period of 14 weeks.

*Result.*—Improvement was marked—return of normal pupillary reaction; patient could walk alone, even in the dark, with only slight ataxia; rode alone in trains; was mentally clear; took interest in his treatment; speech was normal; and there was no incontinence of urine or stool. He was deported, in accordance with his own wishes, to Jamaica; where he arrived safely and without help.

*Remarks.*—This patient also suffered from aortitis and had a rather serious heart condition. His initial dose of the mixed typhoid-paratyphoid vaccine was followed by a violent reaction with epileptiform attacks which lasted over two hours. (He was the first case of the series; and, due to lack of experience, he received an overdose of the vaccine). There was, however, no apparent ill effect upon the circulatory system.

CASE No. 3.—Male negro, age 42 years. (Case No. 5 in last year's series of cases of induced malaria.)

*Diagnosis.*—Cerebrospinal syphilis.

*History.*—In 1928 he was treated for dizziness and paraesthesia (M.T.R. +++ in blood), with intravenous injections of malaria; and only 2 febrile reactions resulted. The parasites remained in the peripheral blood for 13 days. Following the induction of malaria, he received 3.6 grams of neosalvarsan and potassium iodide up to 120 grains daily for over 6 weeks.

*Symptoms.*—The patient returned to the Hospital 6 months later, complaining of disturbances of vision in the right eye. Ophthalmoscopic examination revealed a beginning atrophy of the optic nerve.

*Laboratory Reports.*—The M.T.R. in blood and spinal fluid was negative; globulin test, negative; Boltz's test, strongly positive.

*Treatment.*—He received 12 injections of Bismuth salicylate, 60 grains of potassium iodide daily over 6 weeks, and 3 intravenous injections of typhoid-paratyphoid vaccine (total amount 1,200 millions). He had decided febrile reactions, lasting for about 4 hours, after each injection.

*Result.*—Three months after treatment the patient was free from paraesthesia; had no headaches; Romberg was negative; condition of eye subjectively improved, and vision better. However, examination of the fundus did not reveal any visible improvement. He returned to work.

CASE No. 4.—Male negro, age 55 years.

*Clinical Diagnosis.*—Cerebrospinal syphilis.

*History.*—Two years ago M.T.R. in blood was positive; and 3 months later spontaneous infection with estivo-autumnal malaria occurred. He had had no anti-luetic treatment.

*Symptoms.*—Paraesthesia of both legs, increased and unequal knee jerks; slight ataxia of both arms; and nocturnal headaches.

*Laboratory Reports.*—M.T.R. in spinal fluid and blood serum, positive.

*Treatment.*—Twelve bismuth injections; potassium iodide up to 120 grains

daily for 16 weeks; and 5 mixed typhoid-paratyphoid vaccine injections (1,500 millions) intravenously.

*Result.*—Lost 4 pounds during treatment; but has been working for the past 6 months, with no complaints.

CASE No. 5.—Male negro, age 53 years.

*Diagnosis.*—Tertiary syphilis; hemiplegia.

*History.*—Unknown.

*Symptoms.*—While in the Hospital he had several slight hemiplegic attacks, and severe headaches at night. The blood pressure (not taken during attacks) was 120/90; urine, negative; increased reflexes on the left side of the body; choked disc, left eye; ptosis of left eyelid; and walked with a limp of left leg. Romberg's sign was pronounced.

*Laboratory Reports.*—M.T.R. + + + in blood serum, negative in spinal fluid; Boltz's test, slightly positive.

*Treatment.*—120 grains of potassium iodide daily for 7 weeks; 12 bismuth injections; and 4 mixed typhoid-paratyphoid vaccine injections (1,400 millions), which were followed by very strong reactions.

*Result.*—The patient maintained his original weight; the eye grounds were both normal, with a temporal conus on either side; no ptosis; gait, normal; and no headaches. He did not return for treatment, but returned to work; and, 7 months later, was still free from symptoms.

CASE No. 6.—Male negro, 55 years old.

*Clinical Diagnosis.*—Cerebrospinal syphilis.

*History.*—Two years ago, M.T.R. in blood was positive, and he had two neosalvarsan injections. He discontinued treatment on account of severe headaches and giddiness, which followed the injections and became more intense later.

*Symptoms.*—Increased reflexes of legs and arms; paraesthesia; periods of mental confusion; drowsiness; headaches, which were severe at night; and giddiness.

*Laboratory Reports.*—M.T.R. + + + in blood and spinal fluid, globulin test, slightly positive; cell count, 49 per cu. mm.

*Treatment.*—No bismuth injections; but 75 grains of potassium iodide daily over a period of 6 weeks; and 5 mixed typhoid-paratyphoid vaccine injections (total amount 2,100 millions). He left the Hospital before completing treatment.

*Result.*—The patient's weight increased 8 pounds during treatment. He returned to work on a farm, and was free from subjective symptoms and apparently in good condition 5 months later.

CASE No. 7.—Male negro, 40 years old.

*Clinical Diagnosis.*—Cerebrospinal syphilis.

*History.*—Eight years ago he had 3 injections of neosalvarsan; the following year, 3 more; and 2 years later, about 5 intravenous injections of neoarsphenamin. Two months ago M.T.R. in blood was negative.



*Symptoms.*—The patient came to the Hospital with a slight fever; and tertian malaria parasites were abundant in the blood. He complained of neuralgic pains and paraesthesia in both legs, and severe headaches, which at first were attributed to his malaria. Neurological examination revealed very sluggish pupillary reactions; highly increased reflexes of knee and Achilles' tendons (right more than left); and areas of paraesthesias on legs and arms.

*Laboratory Reports.*—M.T.R. in blood negative; M.T.R. in spinal fluid positive; globulin test positive, Boltz's test positive.

*Treatment.*—Potassium iodide 75 grains daily over 8 weeks; 8 bismuth injections; 5 mixed typhoid-paratyphoid vaccine injections intravenously (total amount 2,150 millions).

*Result.*—Complete absence of subjective complaints on discharge; reflexes still slightly increased; pupillary reactions prompt, and pupils equal in size. The case could not be followed up.

CASE No. 8.—Male negro, 20 years old.

*Diagnosis.*—Cerebrospinal syphilis, (congenital syphilis?)

*History.*—No evidence or history of primary luetic lesion, nor of having received anti-luetic treatment.

*Symptoms.*—Cramps in 4th and 5th fingers of right hand, and attacks of severe headaches. The nervous system was otherwise normal.

*Laboratory Report.*—M.T.R. in blood serum negative; M.T.R. in spinal fluid positive; globulin test positive; Boltz's strongly positive; cell count, 105 cells per cu. mm.

*Treatment.*—Potassium iodide 90 grains daily for 6 weeks; 6 mixed typhoid-paratyphoid vaccine injections intravenously (total amount 1,800 millions); but no bismuth injections.

*Result.*—After 3 intravenous injections of the vaccine, all symptoms disappeared. Three months later the patient was working and well.

#### CASE REPORTS

(Santa Marta Hospital, Colombia)

The following 3 cases were treated in Santa Marta Hospital, where the laboratory examinations were made by Mr. K. C. Brewster.

CASE No. 9.—Male, colored, Latin-American, 26 years.

*Clinical Diagnosis.*—Cerebrospinal syphilis.

*History.*—For past several months increasing disturbance of vision of right eye, and paraesthesia in arms and legs.

*Symptoms.*—Chorioiditis centralis, simple atrophy of optic nerve, and cloudy vitreous of the right eye; and paraesthesia in arms and legs, with pains in bones.

*Laboratory Report.*—Wassermann and Kahn + + + + in blood serum; Wassermann + + + + in spinal fluid; globulin and Boltz's test positive; and cell count 19 cells per cu. mm.

*Treatment.*—Sixteen bismuth salicylate injections; 45 grs. potassium iodide daily for 8 weeks; mixed treatment (potassium iodide and corrosive sublimate) for 3 weeks; 6 intravenous mixed typhoid-paratyphoid vaccine injections (total 1,900 millions).

*Result.*—At the end of treatment the vision in the right eye was almost normal; the vitreous was clear; slight chorioiditis was present around margins of macula lutea, and a slight atrophy of optic nerve was still present. No paraesthesia, and no pains.

CASE No. 10.—Male, colored Latin-American, 23 years old.

*Diagnosis.*—Cerebrospinal syphilis.

*History.*—Nocturnal headaches and paraesthesia of arms and legs.

*Symptoms.*—On admission the patient was very dull, and reacted slowly. He slept very much in the daytime. Pronounced vagotonia, and highly exaggerated reflexes of the legs and arms, with paraesthesias of all extremities, were in evidence.

*Laboratory Reports.*—Wassermann and Kahn + + + + in the blood serum; spinal fluid Wassermann, negative; cell count, 41 per cu. mm.; globulin and Boltz's test, slightly positive.

*Treatment.*—During 6 weeks, 45 grains of potassium iodide daily; 16 injections of bismuth; 5 typhoid-paratyphoid vaccine injections intravenously (all together 1,180 millions).

*Result.*—Mentally, considerably improved; no paraesthesia and no headaches. The laboratory findings after treatment were: Wassermann + + + in blood; Wassermann in spinal fluid, negative; cell count, 5 cells per cu. mm.; globulin test +; Boltz's test + +.

CASE No. 11.—Male, white Latin-American, 26 years old.

*Clinical Diagnosis.*—Tabes dorsalis.

*History.*—Cramps in legs and weakness in knees for ten days.

*Symptoms.*—Absence of knee jerks; could not walk nor stand; and pupillary reactions were sluggish. He developed in the Hospital a complete paraplegia of both legs.

*Treatment.*—He received in 10 weeks about 8 grams of neosalvarsan and 6 bismuth injections, and also potassium iodide. No clinical improvement was noted.

The Laboratory reports after this treatment were: Wassermann and Kahn + + + in blood; Wassermann + + + in spinal fluid; globulin normal; cell count, 3 per cu. mm. After the second fever paroxysm produced by mixed typhoid-paratyphoid vaccine, the patient was able to leave his bed. He received a total amount of 1,000 millions bacteria in 6 intravenous injections; 6 more bismuth injections; and potassium iodide and protoiodide of mercury by mouth. At the end of the treatment the patient was given two more neosalvarsan injections for lancinating pains, with apparent improvement. When he left the Hospital he

walked with very little ataxia; the knee reflexes were present; and the pupils reacted normally.

### SUMMARY

After attempts to produce effective febrile reactions in negro patients suffering from cerebrospinal syphilis, by therapeutical injections of malaria-infected blood had practically met with failure (see Seventeenth Annual Report, Medical Department United Fruit Company); a group of 11 cases of neurosyphilis (8 West Indian negroes, 2 colored Latin-Americans and 1 white Latin-American) were subjected to a combined treatment of potassium iodide, bismuth injections and intravenous injections of a mixed typhoid-paratyphoid vaccine, with more gratifying results. The most beneficial effects in the latter series were obtained in the 2 cases of tabes dorsalis (1 negro and 1 Latin-American) and in the case of general paresis (negro); but in the 8 cases of cerebrospinal syphilis the treatment seemed to improve the visual organic lesions (optic nerve) and influenced very favorably the subjective complaint which had previously incapacitated them for work.

As the injection of salvarsan in cases of old, untreated, or insufficiently treated syphilis, is often followed by untoward effects, which are manifested in the circulatory and the central nervous systems (5 of the 8 negro patients gave a history of insufficient treatment with neosalvarsan); and as the 11 cases reported were restored to work earlier than the author had ever previously observed under treatment with bismuth and potassium iodide, or mercury alone; the combination of these drugs with thermic shocks by means of typhoid-paratyphoid vaccine injections is recommended in a malaria infested population.

The mixed typhoid-paratyphoid vaccine which was given in increasing doses from 50 to 500 millions by intravenous injections produced, almost without exception, the desired febrile reactions.

Though the cardio-vascular systems of several of the patients were in poor condition, in no instance did treatment have to be interrupted nor did a fatality occur. Observations over a longer period will be necessary to determine the lasting effects of this treatment, its influence upon the spinal fluid, and the optimal number of fever paroxysms.

### ADDENDUM

The *Acetic acid—Sulphuric acid Test*, according to Baumann, (Muenchner Medizinische Wochenschrift, Nr. 41, 1928) first described by Boltz and later repeated by Harris (Brit. Med. Journal, 1926, No. 3395), is performed in the following manner: In a small test tube such as that used for a Wassermann reaction, add to 1 c.c. of *FRESH* spinal fluid (which must contain no blood) 0.3 cu. mm. of glacial acetic acid, and shake the tube well. Then add slowly, drop by drop, 0.5 cu. mm. of fresh concentrated water-clear sulphuric acid. The reaction is positive when, either immediately or after 2–3 minutes, a purple color or a purple



ring appears. This color disappears often after one minute. It seldom stays for several hours. The test is negative when the spinal fluid remains clear or changes to a dirty brown yellow color.

The results we obtained with the test differ somewhat from those of Harris and Baumann. I found the test positive in 22 out of 24 cerebrospinal syphilis cases, whereas Harris reports 40 per cent positive. Baumann found a positive reaction in two-thirds of his cerebrospinal syphilis cases. It was positive in all cases of general paresis examined by Baumann, Harris, and myself.

The test is not specific for syphilitic diseases of the central nervous system; as it will be found positive in a number of organic nervous diseases, with central localization, in which acute inflammatory processes are present.

I believe the test to be worthy of further investigation.

## SYPHILIS OF THE BLADDER

### A CASE REPORT

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### PRELIMINARY REMARKS

There is still a great deal of confusion concerning syphilitic lesions of the bladder. Among American urologists, it was for many years generally believed that the bladder was never subjected to syphilitic invasion. The first extensive review of the scattered reports concerning vesical syphilis was made by Duroeux of France, in 1913. He collected 26 cases of tertiary syphilis and 14 cases of secondary syphilis with involvement of the bladder—the majority of which had been recorded by French observers. In Cabot's *Modern Urology*, there is recorded 30 cases observed in the United States.

It is most likely that bladder syphilis has not been reported more frequently because of the difficulty of diagnosis—i.e., there is no reason why syphilis should not localize in the bladder, but syphilitic lesions in that region are not easy to differentiate. Numerous other conditions of the bladder can exist in a person with a positive Wassermann; and, moreover, in many of these cases there are coexistent lesions of the urethra, the prostate gland or the seminal vesicles caused by gonorrhea. Furthermore, we know now that some of the drugs employed in the treatment of syphilis, such as neoarsphenamine, intravenous mercurials, etc., are excellent remedies against ordinary coccal or bacillary infections of the urinary tract; and, consequently, the fact that a bladder lesion disappears after such treatment is in no sense a proof of its syphilitic nature.

The cystoscopic appearance of vesical syphilis closely resembles lesions more commonly recognized—e.g., hyperemia, simple ulcer, or papillary growth. It is evident that the diagnosis can not be based on the cystoscopic findings alone. The syphilitic nature of the process will have to be established by corroborative evidence—viz., the history, Wassermann reaction, and the effects of anti-luetic treatment.

Taking all these facts into consideration, the following case appears to be one of true syphilitic ulceration of the bladder.

*History.*—D. B., aged 65, a colored male, native of Antigua, British West Indies, was admitted to Limon Hospital on July 22, 1929.

*Chief Complaint.*—He complained chiefly of frequency of urination, and soreness over the bladder region.

*Past History.*—The patient denied having had gonorrhea; but had had a hard chancre in 1923, for which he did not receive appropriate treatment. Three years ago he suffered from symptoms similar to those of which he now complained; and was treated by a doctor, who irrigated his bladder twice. The patient had no more trouble until July 22nd, when he entered this Hospital.

*Present Illness.*—He stated that 5 weeks previously he began to suffer from frequency of urination and severe pain at the end of micturition. Furthermore, he asserted that he passed urine on an average of 10 times during the day and 16 times at night, although not more than one ounce at a time; and that profuse perspiration occurred whenever he micturated.

*Physical Examination.*—The patient was well developed, and apparently strong for his age. The physical findings were: pulse and temperature, normal; all teeth had been extracted; eyes, nose, throat, and lungs, negative; heart, slightly enlarged to the left and with an accentuation of the pulmonic 2nd sound; blood pressure, systolic 185 and diastolic 105; some thickening of radial arteries; abdomen, negative; patellar reflexes, diminished; prostate gland, moderately enlarged; there was no urethral discharge nor evidence of stricture; and the penis presented a large indurated scar as the result of the venereal sore referred to in his past history.

*Laboratory Reports.*—Urine: acid reaction, specific gravity 1.020; traces of albumin, no sugar, casts, nor blood, but occasional pus cells. Stained specimens made from the sediment of the urine were negative for bacteria; and the cultures were negative. The hemoglobin index was 75%; the red blood-count, 4,300,000; white, 7,400; Wassermann reaction, strongly positive. The feces were negative.

*Primary Treatment.*—For a few days the patient was given a routine treatment for cystitis—viz., irrigation of bladder with mild silver salts; hot water bags applied over the bladder region; milk diet; urotropin and tincture belladonna internally but without relief. At night, morphine and atropine injections were given.

*Cystoscopic Examination.*—On July 30th a cystoscopic examination was made,

with the following findings: residual urine, 20 c.c.; bladder capacity, 75 c.c. There was marked trigonitis, and hyperemia of the bladder walls but with few trabeculae. Near the orifice of the right ureter there were three small ulcers close to each other. These ulcers were more or less elevated from the surface mucosa; were very much injected; and had sharply defined edges. The bases of the ulcers were of a grayish color surrounded by necrotic debris. A No. 6 catheter passed easily in each ureter.

*Diagnosis.*—At the time of the examination I was inclined to diagnose the condition as tuberculosis of the bladder; taking into consideration the fact that this is a location where tubercular ulcers often appear, and that the symptoms which they produce—frequency, urgency, pain on micturition, vesicle tenesmus, etc.—are all characteristic of vesical tuberculosis. But the absence of hematuria; the pus and bacteria in the urine; and the clear history of syphilis; made me consider this affection as a true syphilitic process.

*Subsequent Treatment and Results.*—Antisyphilitic treatment was immediately instituted, and about the 12th day of treatment all symptoms disappeared and the patient felt well. Three weeks later, before discharging him, another cystoscopic examination was made; and, to my surprise, the ulcers had healed (leaving only a grayish scar) and the capacity of the bladder had increased to 150 c.c.

*Comments.*—This patient was discharged three months ago, but still reports to the Hospital for antisyphilitic treatment. He feels well, and performs his duties without any complaint; and states that he passes urine only once during the night.

## SYPHILIS OF BONES—WITH CASE REPORT

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Puerto Castilla, Honduras

Syphilis, in its various manifestations, is commonly met with in this part of the tropical world. The lesion most frequently encountered is ulcer of the legs, but periostitis of the tibia, aortitis, cirrhosis of the liver, iritis, etc., are also often observed. Patients with primary and secondary lesions rarely present themselves for treatment. Sternal ulcer, as mentioned by Wangenstein, has never been seen in our service; though sternal periostitis, with extreme tenderness, has been noted in a few cases.

Syphilis of the bones is not a common affection of the patients coming under our observation; these patients being predominantly Latin-Americans of mixed bloods, interspersed with a few West Indian negroes and members of other races. However, investigations of fracture cases in which there is delayed union,



often discloses a positive flocculation test, the accuracy of which is confirmed, subsequently, by the clinical test of antiluetic treatment.

Syphilis of the skull occurs in two forms: first, as a periostitis, producing a soft elevation of the periosteum, which is exquisitely sensitive and which may cause much pain, especially at night; and, second, as a gumma, with large areas of necrosis involving both tables but especially the outer one. Each necrotic area is surrounded by an area of osteosclerosis, which gives the lesion a peculiar



PLATE 1

crater-like depression. These lesions are often open by the time that the patient comes to the attention of the physician.

In the case which is reported below, not only the frontal bone of the skull, but also the bones of the right foot, were involved.

#### CASE REPORT

*History.*—L. G., aged 35 years, a native of British Honduras, was admitted to the Hospital on September 16, 1929, for treatment of a swelling on his forehead and a persistent headache which he stated was most severe at night. He had

noticed the swelling about 6 months previously, and had observed that it was constantly increasing in size and tenderness. He had had an abscess of the right jaw in 1926 and, in 1928, received a blow on the same jaw. The wound suppurated and has been discharging pus and serum constantly from that time until he entered the Hospital. He has had a series of deep ulcers on the right ankle, beginning in 1925. Nine months ago he developed a large painful lump on this ankle, which broke down and has been draining pus ever since; and on account of this, he has had great difficulty in walking, even with the assistance of two canes. His right testicle has been swollen, tender and painful for 3 months. He admitted having had gonorrhea, in 1920; bubo, in 1921; and rheumatism, beginning in 1925 and lasting for 3 years; but he gave no history of chancre; skin lesions, other than those mentioned above; loss of hair; or ulcers of the mouth.

*Physical Examination on Admission.*—The patient was a short, heavy set, well developed and well nourished negro man. The blood pressure was: systolic, 110; diastolic, 80. There was a smooth, rounded fluctuant tumor (see Plate No. 1) slightly to the left of the center of the forehead. The skin over it was smooth and unbroken, and normal in appearance except for some enlargement of the superficial vessels. There was a slight impression of pulsation. The ragged edges of bones could be felt on deep palpation, tho the destruction of bone did not seem to involve the inner table of the skull. The edges of the lesion appeared to be raised. Below the jaw, beginning at a point in line with the tip of the right ear and running forward to the midline, there was a narrow linear lesion covered with crusts, the removal of which caused a serous discharge. There was a marked pyorrhea alveolaris, but no palatal scars or perforations. The nasal septum was intact. No abnormalities of the heart, aorta, lungs, or liver were noted. The eyes were normal; reflexes normal; and Romberg's sign was not present. There were no scars on the penis. The right testicle was increased about three times in size; and was hard, low hanging, and very tender. There was an irregular scar of an old bubo in the right groin. The right ankle and foot were swollen and tender, with considerable limitation of motion in the ankle-joint, and loss of flexibility in the foot. There was an open sinus over the mesial surface of the scaphoid, leading to the bone. There were many scars of old healed ulcers on both shins.

*X-ray Examination.*—X-ray of the skull (see Plate No. 2) showed a ragged defect of the frontal bone, about  $1\frac{1}{2}$  inches in diameter, but apparently not connected with the frontal sinuses. In the foot (see Plate No. 3) there was osteomyelitis of the tarsal bones, with a marked degree of rarefaction and some collapse of the scaphoid. The right jaw did not show bone pathology.

*Laboratory Examination.*—The urine showed a slight trace of albumin; the blood was repeatedly negative for malaria; red cell count, 2,000,000; white cell count, 7,500; hemoglobin, 55%; stool was negative; and Meinicke's blood test + + + +. Meinicke's spinal fluid test was negative; and spinal fluid globulin test was negative, with a cell count of 3 to the cu. mm. Thirty cu. cm. of thick

greenish pus was removed from the frontal swelling with a syringe, and cultured, the result showing no growth.



PLATE 2

*Treatment and Result.*—The swelling on the forehead was reduced in size about one-half by aspiration, but the pain and headache continued for a period of ten days. The treatment was routine; potassium iodid by mouth and mercury in-



unctions were given to the point of salivation. Neosalvarsan was administered first on the 29th day, and subsequently given every 5th day until the patient was discharged on October 29, 1929.



PLATE 3

*Examination on December 4, 1929.*—The patient was walking at a brisk rate of speed and without a cane, when he presented himself at the Hospital. The sinus of his foot had healed while he was in the Hospital, and had not reopened. Flexibility of the foot and motion of the ankle had increased greatly, and the

patient expressed the opinion that there was some improvement daily. The right testicle was twice the normal size, and was hard, but was not tender nor painful. The scar below the jaw still showed crusts, in two small areas, from which a slight amount of pus could be expressed. The former site of the frontal swelling appeared as a hardly noticeable depression; indicating that absorption of contents had taken place, although the edges of the crater remained ragged and were raised above the surrounding bone. The headaches had practically disappeared. The neurological examination was negative. Up to this date, December 15, 1929, the patient has continued to return at frequent intervals for examination and treatment.

*Comments.*—This case is reported with the object of emphasizing the great amount and variety of destruction that can take place in an untreated case of syphilis, and to demonstrate that the progress of the disease can be quickly checked by intensive routine treatment. Of course, the damage done to important structures can not be repaired; but a fair degree of function can be obtained. Further special features of this case were: (a) the remotely separated points attacked by the disease, viz: the frontal bone, the testicle, and the bones of the foot; (b) the extent of the damage; and (c) the absolute freedom from nervous and mental symptoms, other than headache.

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### CEREBROSPINAL LUES—CASE REPORT

H. M. WALKER, M.D.

United Fruit Company Hospital

Santa Marta, Colombia

*History.*—A 19-year-old, male Colombian, when he applied for admission to the Hospital, stated that his illness had begun three weeks previously with fever and headache, and a urethral discharge which continued for two weeks. For two days prior to hospitalization he had suffered with pain in the left knee.

*Physical Examination.*—The patient was fairly well developed and nourished; tongue, heavily coated; joints, negative; external genitalia, negative; prostate, normal. The urine contained a trace of albumin and a few pus cells. The blood was negative for malaria.

*Progress of the Case.*—A brief statement of the clinical and laboratory findings and of the treatment given to this patient during the period of hospitalization, follows:

*Temperature.*—For three days subsequent to admission the temperature ranged between 101°F., and 102°F. The 4th day it was normal; but there were irregular elevations until the 12th day, and on the 9th and 11th days it reached 104°F.

*Laboratory Findings.*—On the 2nd day of hospital treatment a blood culture and Widal's test were negative, but the Wassermann and Kahn tests made at the same time both showed. + + + +.

On the 4th day the patient complained of severe occipital headache, and a slight rigidity of the neck was apparent although pupils and reflexes were normal. A spinal puncture was performed; and the laboratory findings showed 2,400 cells with 60% lymphocytes. The Wassermann test was + + + +, but smears of the sedimented fluid contained no organisms and a culture was negative.

On the 7th day, a blood count showed 19,650 leucocytes with 81% polymorphonuclears; while the spinal fluid contained 1,648 cells with lymphocytes predominating.

From the day of admission until the 12th day, the patient had a persistent headache; but he had no pain in the left knee after he entered the Hospital.

*Methods and Results of Treatment.*—After the positive spinal fluid Wassermann test on the 4th day, the patient was treated with iodides and small doses of neosalvarsan and the improvement was rapid. The rigidity of the neck was not present after the 14th day. Cell counts of the spinal fluid obtained on the 12th, 14th, 17th, and 21st days were 1,680, 1,150, 151 and 177 respectively, with the lymphocytes predominating and the globulin increased in all examinations.

*Comments.*—On the 26th day the patient was allowed to leave the Hospital, as he had maintained for more than a week that he was not ill and had threatened to leave without permission if he was not voluntarily discharged. Up to the time he was discharged, he had received 2.85 gms. of neosalvarsan. He promised to return for further observation and treatment; but he failed to do so, and repeated efforts to locate him were unsuccessful.

Eleven months subsequent to his discharge, the man appeared at the Clinic. His record card indicated that he had received no treatment in the interim from the Medical Department of the United Fruit Company, and he stated that he had not been treated elsewhere. A spinal puncture was made; and the spinal fluid contained 6 cells, the Wassermann reaction was negative. Wassermann and Kahn tests of his blood showed a 2-plus reaction. He was given 0.9 gm. of neosalvarsan. He agreed to return for reexamination and further treatment within a week, but he has not reappeared up to this date (3 months later).



## GONORRHOEAL CONJUNCTIVITIS—CASE REPORT

L. R. FLETCHER, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

HISTORY.—L. B., male infant, aged 11 days, was admitted to the Hospital October 13, 1929, for treatment of an infection of the eyes. The father stated that the child was born at home, with a midwife in attendance; and that the birth was apparently normal. The midwife did not treat the eyes of the baby after birth. When the baby was 4 days old, the parents noticed that the eyelids were swollen, and that there was a profuse discharge of yellow pus. No treatment was administered until the child was brought to the Hospital.

PHYSICAL EXAMINATION.—The lids and conjunctivae were markedly swollen and red. There was a profuse, purulent discharge from both eyes. In the center of the left cornea, there was a dull grayish spot about 3 mm. in diameter which appeared to be the beginning of a corneal ulcer. No other abnormal conditions were observed.

LABORATORY FINDINGS.—Smears taken from each eye were positive for gonococci. A blood smear was negative for malaria.

TREATMENT AND PROGRESS.—The eyes were irrigated every 2 hours with 1 pint of sterile ice-water, and one drop of 4 per cent. protargol solution was instilled in each eye after each irrigation.

*Oct. 20th.*—The quantity of pus in each eye was markedly diminished, and a definite shallow ulcer was present in the center of the left cornea.

*Oct. 25th.*—The swelling and redness had entirely disappeared; and there was very little pus in the eyes, although the ulcer was somewhat deeper than before. Smears from each eye were still positive for gonococci.

*Nov. 4th, 5th, and 6th.*—Smears were taken from the eyes, and, on each day, they were found to be negative for gonococci. The ice-cold irrigations and protargol instillations were discontinued. Although the corneal ulcer was somewhat deeper, it had not eroded through the cornea. Irrigations of boric acid solution were given every 6 hours, and a drop of  $\frac{3}{4}$  per cent. zinc sulphate solution was instilled in each eye after the irrigations.

*Nov. 17th.*—Another smear was taken from each eye, and found negative for gonococci.

*Nov. 20th.*—The ulcer was practically healed, leaving only a slightly grayish scar, and the patient was discharged.

CONCLUSIONS.—(1) That ice-cold irrigations give better and quicker results in the treatment of gonorrhoeal ophthalmia than any method of treatment used previously in this Hospital.

(2) That there is no valid contraindication to the use of this method of treat-

ment in gonorrhoeal vaginitis, and in gonorrhoeal urethritis in the male. This treatment has been used on 1 case of gonorrhoeal vaginitis and 1 case of gonorrhoeal urethritis of the male, with very gratifying results in both instances. At a later date, the results in a series of cases treated in a similar manner will be reported.

## NIGHT-BLINDNESS IN RAILWAY SECTION LABOURERS WITH CASE REPORTS

N. P. MACPHAIL, M.D.

United Fruit Company Hospital

Quirigua, Guatemala

### PRELIMINARY REMARKS

In 1909 and 1910 the writer noted that a number of the patients, who were admitted to the Hospital for various medical and surgical conditions, complained of being unable to see at night. It appeared to be a perfectly genuine source of worry to them; and was specially noticeable in an occasional case as, when the patient was ready to be discharged, he insisted that he be allowed to remain in the Hospital until he was "able to see at night." As the Hospital accommodations were limited, the condition proved of interest from an economic standpoint and attempts were made to determine the cause of the affection.

All patients showing this symptom were ascertained to be labouring on the railway tracks, and in no instance did it appear among the labourers working in the woodlands or banana fields. All available literature was consulted, but none of the text-books or reference books contained comprehensive descriptions of night-blindness.

One text-book (name forgotten) described night-blindness as a functional disease, and said that it was similar in some respects to snow-blindness. It stated that it occurred among those persons who were exposed to bright sunshine, and was observed most frequently in people in a debilitated condition. The only treatment suggested was removal of the cause, and the administration of a tonic.

*Possible Aetiological Factors in Guatemala.*—As all of our labourers were more or less exposed to bright sunlight, and as the majority were debilitated from malaria, intestinal parasites, poorly balanced diets, alcoholism, etc., it was difficult to determine why the condition should develop only among labourers employed in the railway section-gangs.

Practically all the patients included in the first series of cases observed gave a history of alcoholism; all of them worked on the section gangs, which entailed 10 hours work daily on the railway track, and all entered the Hospital primarily for the treatment of malaria.

Examination showed no inflammation of the conjunctiva or cornea, and no photophobia or spasm of the lids. Their vision showed no evidence of being limited or impaired during daylight, and those who were literate experienced no difficulty in reading the smallest type on either cloudy or bright days.

The writer suspected, at first, that the patients were malingering, and were simulating this condition in order to remain in the Hospital for a few additional days; but subsequently reached the conclusion that this theory was not justified. The symptoms of some of the patients seemed to be especially severe, as they claimed that they were "blind" early in the evening. No refractive errors were detected (our equipment for examination was of a primitive type); no congenital defects, such as albinism, were present; and no evidence of macropsia or micropsia was found.

Consultations with visiting doctors gave no light on the subject; though one eminent eye specialist expressed his opinion that the symptoms were probably caused by an interference with the functioning of the rods and cones of the retina, and stated that an exudate might be caused by the bright sunlight reflected from the shining steel of the rails and the limestone ballast of the roadbed.

All the patients who complained of this condition sturdily maintained that they could not see at night, and they preferred to stay in the Hospital until the symptoms disappeared. Most of these individuals asked to be discharged after 12 to 20 days in the Hospital, stating that they were better and could see at night. The usual quinine and tonic course prescribed for malaria was the only medication administered in those early days; and all the patients, without exception, recovered within a period of less than 20 days.

*Night-blindness in the Far North.*—About 1915, the writer read in a magazine an article written by a man (name forgotten) who had been among the Esquimaux in the far North. It was entitled, "Night-Blindness Among the Esquimaux," or words to that effect. It discussed a condition which developed among the Esquimaux who accompanied him on the trip, and which resulted in their inability to see at night. The author described his attempts to diagnose the cause, and to find a cure, for the condition; and stated that latterly he had completely cured all such cases in a very few days by merely giving each sufferer several glasses of fresh milk daily. He carried frozen milk in his stores.

*Favorable Results from Dietetic Treatment.*—After reading the article mentioned above, large quantities of fresh milk were given to patients who complained of night blindness; and it was observed that they responded much quicker than they had previously when they received only the ordinary hospital diet. This suggested the possibility of the condition being due to a deficiency in diet. A review of many charts showed conclusively that all these cases had come from section gangs; and, furthermore, practically all the persons suffering from the ailment were labourers employed on the portions of the railway which did not go through banana country and where the feeding of the gangs was supervised by the corporal in charge.



An investigation revealed the fact that these gangs were on a badly-balanced diet. They had meat once a week; while milk, green vegetables, and ripe or green bananas, were never included in their rations. The total food allowance consisted of corn cakes (tortillas), beans, rice, and coffee with sugar. The 3 daily meals were similar.

More recently (1924-1925) all cases who complained of night-blindness received large doses of cod-liver oil, and increased quantities of milk were added to the usual well-balanced hospital diet. This resulted in the symptoms disappearing even more promptly; and under this method of treatment all patients recovered their ability to see at night in less than 10 days, and the majority were cured within 5 to 7 days.

I have no recollection or record of any case applying for hospitalization, in the earlier days, with night-blindness as the primary cause. Latterly, however we have had patients seek treatment for relief of this condition. Cases are less frequently encountered now than in the earlier years, and it is the writer's belief that it has become more rare as a result of a general improvement in the routine diets served to section gangs.

Reports of two typical cases are appended:

#### CASE No. 1.

*History of Present Illness.*—L. P., a native, male labourer in a railway section gang, aged 29, who had been employed as a railroad labourer for 10 years, stated that, for the preceding 4 days, he had been unable to see at night. He had had fever and headache for two days, before he sought medical treatment. There was no apparent impairment of the vision during the day time.

*Complete Abnormal Conditions.*—The physical examination made at the time of admission showed:

*Heart:* Mitral, systolic murmurs.

*Spleen:* Enlarged, ++.

*Eyes:* Slightly injected, but otherwise apparently negative.

*Stool:* Negative.

*Urine:* Negative.

*Blood:* Negative for malaria; anemia, +; Meinicke's test, negative.

*Treatment.*—He was given the routine treatment for malaria, consisting of calomel, salts, and quinine, and also 2 ozs. of cod-liver oil daily; and was placed on a full diet, supplemented by an additional quantity of fresh milk.

*Final Diagnosis.*—1. Night-blindness. 2. Splenitis (Malarial ?)

*Result.*—The patient was discharged on the 7th day, when his vision at night was normal.

#### CASE No. 2

*History of Present Illness.*—P. F., a native, male labourer in a section gang of the International Railways of Central America, aged 44, stated that he suffered

for 4 days with a pain in the right side of his neck, which was aggravated by any motion of the head to the right; and that, for a period of 15 days, he had been unable to see anything at night.

*Complete Abnormal Conditions.*—When the physical examination was made at the time of admission, torticollis was marked, with painfulness and tenderness of the muscle groups on the right side of the neck; and pyorrhea was present in a mild degree.

*Heart:* Sounds, distant.

*Spleen:* Palpable, +.

*Lungs:* Emphysematous.

*Eyes:* Negative.

*Stools:* Uncinaria and Trichocephalus.

*Urine:* Negative.

*Blood:* Negative for malaria; anemia, +; Meinicke's test, negative.

*Treatment.*—The medication consisted of calomel, salts, and quinine for malaria; chenopodium, for intestinal parasites; sodium iodide intravenously; and 3 ozs. of cod-liver oil daily. He was placed on a full diet, and also given additional quantities of fresh milk.

*Final Diagnoses.*—1. Torticollis. 2. Night-blindness. 3. Intestinal parasites.

*Results*—The patient was discharged on the 10th day. His neck was free from pain, and his night vision was normal.

## LEISHMANIA TROPICA—A CASE REPORT

ARNOLDO LACHNER CHACON, M.D.

United Fruit Company Hospital

Limon, Costa Rica

It is well known that the ulcers produced by *Leishmania Tropica* are localized preferably in the lower third of the legs, and with less frequency in the two upper thirds; the localization of these in the face being very rare. For this reason we are moved to report on the following case:

The patient D. M. D., age 45 years, West Indian Negro, laborer, was admitted to our hospital with two ulcers of the face. He stated that 20 days prior to admission there appeared on his face two small abscesses—one on the right side of his chin, and the other on the right side of his cheek. The abscesses increased in size until they ruptured and the ulcers he now presents resulted.

The ulcers are large and circular in shape, with edges rather thickened, leading one to think of a tumor. In the center of each of them there was to be seen a deep crater which was covered with a layer of mucopurulent secretion. The patient's temperature was sub-febrile oscillating between 99° and 100°.

Smears taken from the ulcers showed the presence of *Leishmania* bodies in vast numbers.

*Treatment.*—Intravenous injections of a 1% solution of Tartar Emetic in doses of 2 c.c. on alternate days were administered until the patient had received a total of 16 injections. During the first week of hospitalization, he received 15 drops of a saturated solution of Potassium Iodide, three times a day by mouth; and the dose was then increased to 20 drops t.i.d. for the entire period of treat-

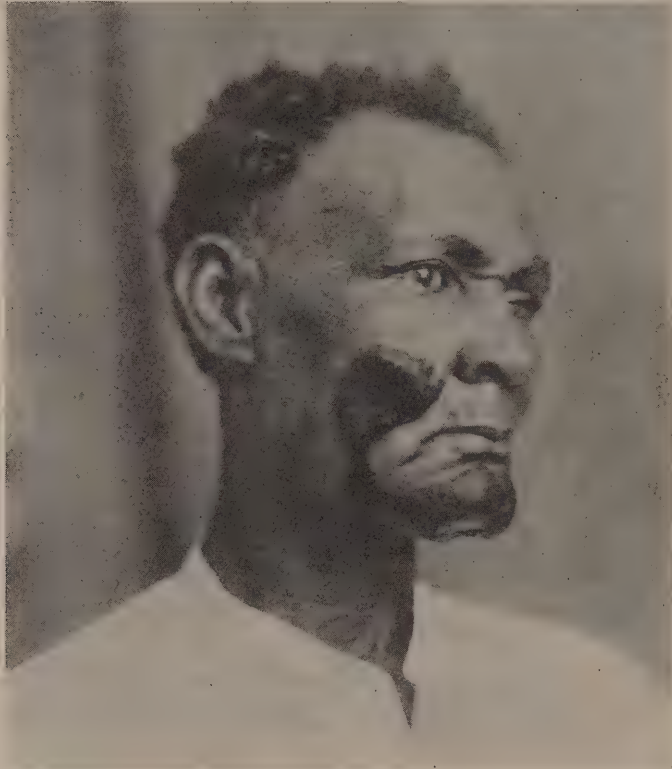


FIG. 1

ment. Local treatment consisted of bathing the infected area with Dakin's solution alternated with a 5% novarsenobenzol solution with glycerine, until healthy granulations appeared; and subsequently until healed applications of mercurochrome solutions and zinc oxide ointment.

The patient's temperature began to subside slowly, but did not reach normal until the fourth week of treatment. He was discharged on the 50th day after admission to the Hospital.

The accompanying picture demonstrates the lesions.



## TROPICAL ULCER—WITH CASE REPORT

L. R. FLETCHER, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

The disease entity commonly known as tropical ulcer has been described and discussed from time to time by various physicians practicing in the tropical latitudes. Tropical ulcer is probably one of the most common skin diseases found in the tropics and, undoubtedly, causes more frequent disability and longer hospitalization than any other tropical skin disease. Liberty is taken to report this case because of the unusual size and form of the ulcer and on account of the extensive damage to adjoining tissues. From an economic point of view, the method of treatment is stressed.

## CASE REPORT

*History.*—E. J., a native of Honduras, aged 26 years, entered the Hospital September 1, 1929, because of a large ulcer on his left leg. The patient stated that this ulcer had appeared about 2 years previously, while he was working in low, swampy land. His feet and legs were exposed and his leg was scratched by a thorny bush, causing a small, burning blister to develop in about a week; 3 days later this blister broke and an ulcer  $\frac{3}{4}$  of an inch in diameter appeared. He did not seek medical attention and the ulcer gradually grew larger and deeper, for approximately one year. It then began to fill up and a large, raw, protuberant growth developed slowly on the ulcer site. The history of previous illnesses included several attacks of malaria, acute conjunctivitis, and numerous small ulcers which had appeared singly on either leg at various times. He asserted that it had always been necessary to submit to treatment before these old ulcers would heal.

*Physical Examination.*—(See Plate 1.) The patient was a poorly nourished male, but not acutely ill. Several carious teeth were found. The heart, lungs, and abdomen were negative, except that the spleen was slightly enlarged. There was a moderate degree of inguinal adenitis on both sides. Blood pressure was 118 systolic and 70 diastolic. On the anterior surface and lower third of the left leg, there was a large exuberant growth of granulation tissue 6 inches long by  $4\frac{1}{2}$  inches wide, and about 3 inches deep. This granulating ulcer had a very putrid, offensive odor, and was exuding pus profusely. The skin immediately surrounding the ulcer, for a distance of about one inch, was deeply pigmented. On the lower third of the other leg, there were many dark, pigmented, and atrophic scars resulting from previous ulcers.

*Laboratory Examination.*—Urine, negative; blood, negative for malaria; Meini-cke's Turbidity Reaction test on blood, negative; stool, positive for ova of Anky-



PLATE 1



PLATE 3

lostoma duodenale and *Trichocephalus dispar*. Smears from the ulcer showed a gram-negative fusiform bacillus 4 to 8 microns in length; a *Spirochaeta*, 10 to 20 microns in length, resembling *Spirochaeta refringens*; many staphylococci; and few diplococci.

*X-ray Examination.*—On the anterior surface and lower third of the left tibia and fibula, there was a smooth regular exostotic growth about 3 inches long and

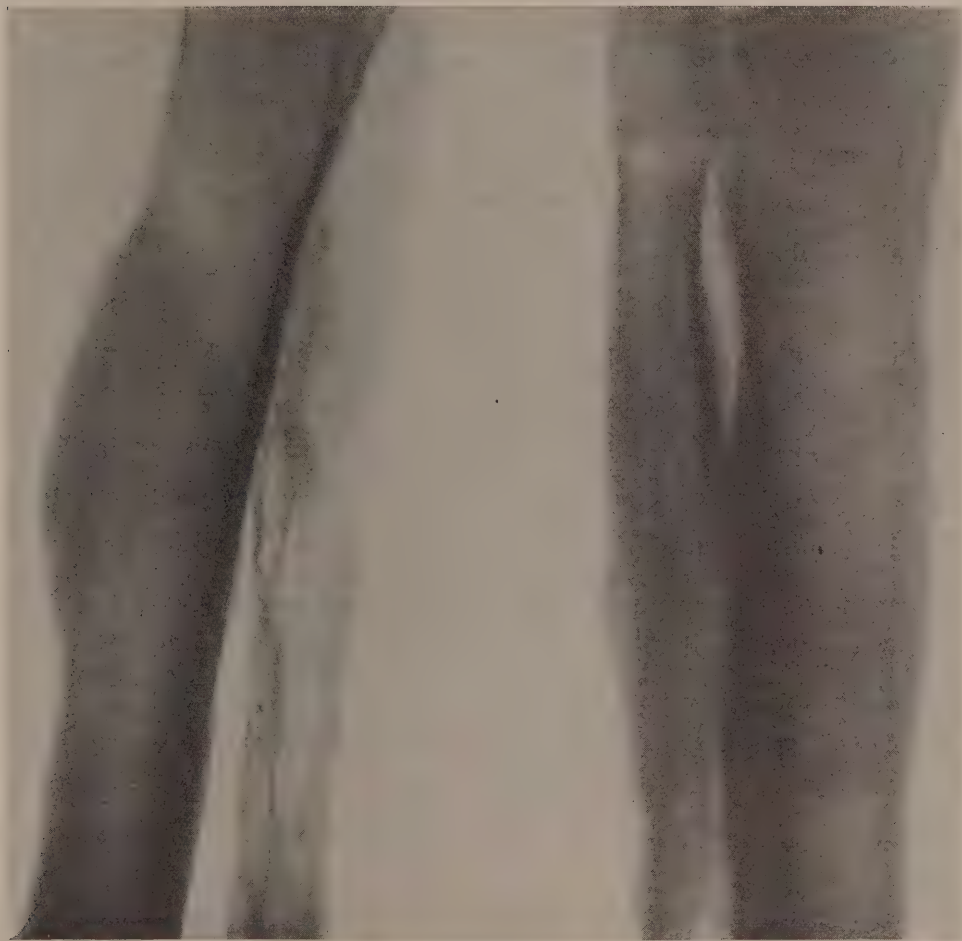


PLATE 2

about  $\frac{3}{8}$  of an inch deep. (See Plate 2.) The cortex of the tibia beneath this growth looked somewhat less dense than normal.

*Treatment.*—Large, wet, boric acid dressings were kept on the ulcer until the saprophytic infection was somewhat eliminated; then the large, granulated, ulcerous growth was excised by means of thermo-electric cautery, under spinal anesthesia. Wet boric acid dressings were kept on the ulcer until healthy



granulations appeared. Numerous small skin grafts were then transplanted and, after these were firmly adhered to the granulating surface, dressings wet with boric acid solution were again applied for a short time. Epithelization was complete on December 1, 1929, and the patient was discharged. (See Plate 3.)

#### COMMENTS

The ulcer reported in this case was considerably larger than is usually encountered. Rarely is an ulcer seen that has been neglected to such an extent and upon which such an extreme proliferation of granulation tissue has taken place.

Manson-Bahr<sup>1</sup> and Castellani & Chalmers<sup>2</sup> state that this disease may extend down to and involve the periosteum of the underlying bone. The x-ray plate shows that such a condition has developed in this case.

Tropical ulcers usually appear upon the lower  $\frac{1}{3}$  of the legs or the dorsum of the feet, and are most frequently crater-like if of short duration. At a later stage, this crater may fill with granulations, and many cases present themselves for treatment at this time.

Very marked, dark pigmentation of the skin surrounding tropical ulcers and over areas where the ulcers have healed is practically constant, and appears to be a condition characteristically associated with the lesion.

Jimenez<sup>3</sup> divides tropical ulcers into two classes; the atonic and the malignant forms. In our experience, the atonic form is more prevalent in this region.

In the diagnosis of tropical ulcer, framboesia, syphilis, oriental sore, *ulcus cruris varicosum*, ulcers of tuberculous origin, blastomycosis, sporotrichosis, *alcadiosis* and *mycosis fungoides* must be differentiated.

Although less responsive to treatment than most ulcers, the infection of tropical ulcers can be eliminated with proper antiseptic dressings and, at the proper time, their evolution greatly hastened by the application of skin grafts. On account of the large areas often involved, and because these ulcers always epithelize so slowly, hospitalization is quite prolonged unless skin grafts are applied.

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## VON RECKLINGHAUSEN'S DISEASE

A. CUFF LUSHINGTON, M.D., C.M.

United Fruit Company Medical Department

Kingston, Jamaica, B. W. I.

*History.*—W. I. M., coloured Jamaican, aged 38 years, presented himself for examination to determine whether or not his physical condition warranted his employment for service on the Company's Engineering staff. He had been married for 6 years, and had 3 healthy children. He stated that he had had measles when a child, and occasionally contracted slight colds; but had never suffered from any serious disease, nor had he experienced any disability or loss of time from work as the result of illness. From birth, he had had marks, moles, and small swellings on his body; and the growths gradually increased in size, but caused no pain or inconvenience whatsoever. He gave no history of venereal infection.

*Physical Examination.*—At the time of the examination, the following findings were recorded:

*Face.*—There was a puffy appearance under the lower lids and over the malar eminences.

*Teeth.*—Some dental attention was indicated.

*Tonsils.*—Both enlarged.

*Chest.*—Well formed.

*Skin.*—There were a few scattered moles on the trunk. The skin, beginning at a point 2 inches below the umbilicus and extending downward almost to the knees of both legs, showed a dark bluish pigmentary stain. This pigmentation encircled the body; and numerous large and small moles appeared here and there through the diffuse discoloration. There were a few small tumors in the skin, ranging from the size of a large pea to that of a hen's egg; and 4 large tumors about the size of a grapefruit (1 on the left side above the iliac crest, and 3 on the buttocks), which were irregular, wrinkled, fold-like masses, hanging down from a base as large, fleshy growths that could be easily raised with the hand. These felt soft and boggy, to the touch; and were painless, to such an extent that he experienced no discomfort either when sitting or lying on them. From the knees downward, the skin was discolored in patches and dotted with numerous moles. A small leucodermal area appeared on the right side of the back.

The clinical and laboratory examinations were otherwise negative.

*Comments.*—A. Thompson, of Edinburgh, in his monograph "On Neuroma and Neurofibromatosis," published in 1900, gives a classification in which Recklinghausen's disease is included under "False Neuroma"—that is, diffuse overgrowth of connective tissue, sheaths and ganglionic enlargements (i.e., cutaneous neurofibromata). The cause of benign neuromata is not known, but trauma may be a predisposing factor. They may have their origin in the perineurium, epineurium or endoneurium; are composed chiefly of connective tissue; and may become cystic. The true neuromata are very rare; and are said only to occur in



FIG. 1



FIG. 2

connection with the sympathetic nervous system. Von Recklinghausen first demonstrated the true nature of these growths in 1882.

The only treatment is essentially surgical. In this particular case, as the applicant suffers no inconvenience nor pain, and is able to perform his duties, he will be kept under observation from time to time.

The photos appearing above give a very good idea of the condition.



## A CASE SIMULATING MALIGNANT EDEMA

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Owing to the rarity of cases of malignant edema reported in the medical literature, it seems worthwhile to record a case that recently received treatment in this Hospital, which I believe to have been due to this disease.

## CASE REPORT

*History.*—N. L., a well developed but poorly nourished native, was admitted to the Hospital on January 17, 1930, in an unconscious condition. A relative gave the following history: age, 30 years; had been working for some time digging ditches in wet ground; and became ill 2 days before admission, with severe chills (as the first symptoms), high fever, and swelling of the left foot.

*Physical Findings.*—The liver and spleen were enlarged; heart sounds, indistinct and very rapid; inguinal glands, palpable. The left foot was edematous, but there was no discoloration. It presented a vesicle about  $1\frac{1}{4}$  inches in diameter, localized on the external region of the dorsum of the foot over the astragalus, and surrounded by an area showing very slight crepitations on pressure. I opened the vesicle; and noticed that there was gangrenous involvement of the dermis and subcutaneous cellular tissues, which had a characteristic odor. There were no other abnormal findings.

*Tentative Diagnosis.*—Malignant edema of left foot.

*Treatment and Clinical Developments.*—A blood culture was made on the day of hospitalization, and the patient was isolated. The temperature on admission was 99.5 F., the pulse rate was 128, and the respiration rate was 28. Local and general supportive measures were instituted; and 10 c.c. of a 1% solution of mercurochrome were administered intravenously on the day of admission and this dose repeated on the 2nd and the 5th day of treatment. The temperature continued to rise, with daily remissions, and on the 5th day reached 105.2 F. On this date the pulse rate was 144, and respiration rate, 54. The edema disappeared promptly, and the foot became dry, although gangrenous destruction of the adjacent tendon sheaths, with slight suppuration, was noticeable. At the time of death, this circumscribed lesion, where the skin and cellular tissue were destroyed, involved an area which was approximately one-sixth larger than the primary lesion.

*Laboratory Findings.*—The laboratory examinations were conducted by Mr. L. R. Mathews, Technician, who reported:

Plate of Loeffler's Blood Serum inoculated with 1.0 c.c. of patient's blood, showed—36 hours, few small greyish colonies; 48 hours, shining, greyish colonies about 2 cm. in diameter.

Smears collected from haemolytic fluid, stained with pure methylene blue cold

aqueous solution, showed a pure culture of gram-negative vibriion—long, slender bacilli, some with spores, some morphologically identical with the gas bacilli group. Identification of the type was doubtful, and 2 slides were submitted to Dr. F. B. Mallory, Boston, for confirmatory diagnosis.

Urine showed albumin ++, pus ++; stool, pus ++; blood, negative for parasites; white blood-count, 23,000.

*Pathological Report.*—The report received from Dr. F. B. Mallory read:

Smears from a mixed culture show a slender gram-negative and a shorter, thicker gram-positive bacillus. The latter has spores situated towards the ends of the rods. The appearance is consistent with that of the bacillus of malignant edema, but it would require pure cultures and serum tests to demonstrate the exact nature of the organism.

*Postmortem.*—The pathological findings during postmortem examination were: lungs, apparently normal; heart, large and dilated, with walls thin and brownish in color—endocardium showed few areas of white plaques; abdomen, the peritoneal fat had a yellowish tint; liver, weight 1,500 grams, soft, and reddish-brown color; spleen, weight 250 grams, slate color, capsule wrinkled; kidneys, weight 200 grams each, color pale, capsule stripped easily. Other organs appeared normal.

*Final Diagnosis.*—Malignant edema.

*Result.*—The patient never recovered consciousness, and died 5 days after admission.

## SYRINGOBULBIA—A CASE REPORT

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United Fruit Company Hospital

Almirante, Panama

Mrs. M., white, married, American, aged 58, presented the following history and findings:

*Family History.*—The patient's father died of insanity after sun-stroke, and her mother died of old age. She has an older brother and sister living and well. One brother was killed in an accident.

*Past History.*—She had an ovarian operation and appendectomy in 1904, and a goitre was removed in 1905. In her 33 years of married life she has been pregnant twice—both miscarriages. She has lived in the tropics for a period totaling about 9 years.

The writer saw her for the first time, when she was admitted to the Almirante Hospital in July, 1925, for hysteria following some slight social difficulty. Subsequently, she received medical attention on several occasions for various conditions: from Sept. 9th to Sept. 14th, 1925, for an infected monkey bite; on

Nov. 11th, 1925, for influenza; in March, 1928, for arthritis deformans, which was treated dietetically and with salicylates; in June, 1928, for acute rhinitis and pharyngitis, which developed later into a laryngitis and tracheitis.

In July, 1928, she was admitted to the Hospital for influenza. During this admission, the physical findings were: (a) a most persistent pharyngitis and laryngitis which showed no tendency to yield to treatment—the mucosa of the pharynx was congested and hypertrophic; (b) blood pressure, 160 systolic and 120 diastolic; (c) facial eczema; (d) a choking sensation in throat and chest, which was more marked while eating and was considered as a “globus hystericus;” (e) broncho-vesicular breathing in apices of both lungs; and an x-ray of the chest showed numerous calcified spots in both middle and lower fields and a protruding aortic bulb.

The rhinitis and pharyngitis persisted, and during the period extending from August to November, 1928, she was treated 7 times in the Outpatient Clinic. There developed severe neuralgic pains in the upper right arm; which suggested a subacromial bursitis, inasmuch as she was unable to abduct her arm quite up to a horizontal position. Her blood pressure rose very rapidly; and she developed a most annoying tinnitus aurium.

On Nov. 20th, 1928, she was admitted to the Hospital again, and complained of a severe diarrhoea which was attributed to food poisoning or some dietetic indiscretion. The pharyngitis, rhinitis, and tinnitus aurium still gave her annoyance; the pains in her right shoulder and arm were severe; and the systolic blood pressure had risen to 200. She remained in the Hospital for 16 days. On the 6th day of hospitalization her temperature rose to 102°F.; on the 7th day it was 103°F.; on the 8th day it fell to 101°F.; and on the 9th day and subsequently it was normal. Her enteritis may have been an intestinal complication of the persistent influenza. At this time, she complained of her tongue becoming “thick,” to such an extent that it interfered somewhat with speech.

The laboratory findings were as follows:

*Urine.*—Reaction, usually acid, but sometimes neutral; specific gravity, between 1.010 and 1.020; albumin, usually negative but a faint trace present during the fever; sediment, usually negative but did show pus on 2 occasions.

*Stool.*—Persistently negative.

*Blood.*—Haemoglobin, 75%; white blood-count, 10,800; thick and thin blood films, negative for malaria; red blood-count, 4,000,000.

*Differential blood-count:* Polymorphonuclear neutrophiles, 89%; transitionals, 2%; lymphocytes, 6%; large mononuclears, 1%; eosinophiles, 1%; mast cells, 1%.

It may be mentioned here that the Meinicke test was negative in 1927, and again in April, 1929.

During her stay in the Hospital, her blood pressure was gradually reduced from 200 to 140 systolic and 120 diastolic.

After her discharge we saw her regularly in the Outpatient Clinic. She could



tolerate only small doses of iodides. Her blood pressure fluctuated between 175 and 200 systolic; the tinnitus aurium increased in ratio to the rise in the blood pressure; and the throat condition did not improve. At first, the presence of a laryngeal neoplasm was suspected, and a careful laryngoscopic examination was made. Nothing of that nature was found, but there was a definite paralysis of the right side of the tongue near the base, and the papillae in this region appeared to be undergoing atrophy. The speech remained defective, her voice was somewhat weak, and she continued to experience some discomfort in swallowing.

In June, 1929, she made a trip to England with her husband; and the writer gave her a letter to an acquaintance, who is a nose and throat specialist in London. His report is quoted below:

Mrs. M., whom you kindly referred to me came a few days ago. I found paralysis of the right half of the tongue and palate, and of the right vocal cord and shoulder. I sent her on to a nerve specialist for examination of the nervous system and I send you his note giving his findings.

I did not find any local condition in the ears and the hearing is good in each ear, so I think the tinnitus is of vascular origin.

(signed) Lionel Colledge.

The nerve specialist's report was as follows:

I have just seen Mrs. M. On the whole I think she is in all probability a case of syringobulbia, and not one of neoplasm.

The wasting of trapezius appears to be of more than a year's standing and to have antedated her other symptoms by some months.

Although the right half of the tongue is greatly wasted and fibrillating, there is also unmistakable fibrillation of the left half—which makes a local lesion of the hypoglossal in its peripheral course most unlikely.

Also, there is profound sensory loss over the anterior part of the right half of the tongue and some doubtful pain loss over part of the right face—suggesting a lesion of the spinal nucleus of the fifth nerve.

She has no enlarged glands that I can feel, and her general condition does not suggest a neoplasm of over a year's standing.

Her blood pressure is 190—hence her tinnitus, presumably.

On the whole, I do not feel justified in countermanding her return home, as I am convinced in my own mind that she has syringobulbia. For this, all I can suggest in the way of treatment is keeping her on moderate doses of iodide, and if the condition progresses appreciably, x-ray therapy might be considered, though I have never seen much benefit accrue from it in syringomyelia. Some of the Queen Square people, however, swear by it.

(signed) F. M. R. Walshe

Her skull was x-rayed, but the report has not yet been received.

Osler, in his article on syringomyelia, says:

Bulbar Symptoms.—When the disease affects the bulb either primarily or as an extension from the cervical region of the spinal cord the clinical picture is often described as "syringobulbia." Atrophy of the tongue, unilateral or bilateral, paralysis of one or both vocal cords or palatal arches are among the more constant symptoms. Facial paralysis is more rare, and ocular palsies very exceptional.

On the other hand, nystagmus is a common feature, and this may be lateral,

vertical or rotary. The latter type was present in 2 out of 40 cases, and the former was of frequent occurrence. Sensory disturbances in the area supplied by the trigeminal nerve are often present, even without other bulbar symptoms. Defects in articulation, deglutition, and phonation are the results of the various palsies mentioned.

The only special senses to be interfered with in any degree of frequency are those of taste and hearing, and even these are usually intact except in severe examples of the bulbar form. Vision remains unaffected almost without exception, but H. S. Hutchinson has once observed degeneration of the optic nerves.

## ENCEPHALITIS LETHARGICA—CASE REPORT

H. M. WALKER, M.D.

United Fruit Company Hospital

Santa Marta, Colombia

*History.*—A Colombian soldier, aged 21 years, had lived in the highlands of Colombia until six months prior to the time he entered the Hospital. There was nothing of consequence in his past history. The illness which caused him to seek Hospital treatment began 4 days before admission; and the patient stated that during the intervening days he had had a constant headache, and continuous fever with intermittent chills.

*Physical Examination.*—The patient's temperature was 103.5°F., and the pulse rate 96; but there were no other apparent abnormal conditions. The blood was negative for malaria, and the urine was negative.

On the 2nd day of hospitalization, a blood culture, and Widal, Wassermann, and Kahn tests were all negative.

From the day of admission until the 4th day of confinement, the daily clinical examinations were fruitless. The white cell count on the 4th day was 15,500. The only complaint was a slight headache; and, although there was a continuous temperature, it never exceeded 103.5°F. and fell by lysis until it was normal on the 5th day.

An examination on the 5th day revealed a slight rigidity of the neck; and the knee-jerk reactions were absent. A spinal puncture was made, showing 544 cells with 70% lymphocytes, glucose 66.5 mgs., globulin ++. No organisms were found in smears made from the sedimented fluid; and culture and guinea-pig inoculation later proved to be negative. The spinal fluid Wassermann and Kahn tests were negative.

The patient, who had not appeared seriously ill at any time, read considerably and mingled freely with the other patients. During the first 4 days, no treatment was administered other than an aperient and a combination of aspirin, phenacetin and codeine to relieve the headache; but on the 5th day, and subsequently, he was given 10 grs. of hexamethylenamin 3 times daily.

On the 7th day a spinal fluid examination showed 53 cells with lymphocytes predominating, glucose 74 mgs., globulin +. The following day there was a slight ptosis of the right eyelid; and this became more marked on the 10th day, when the right side of the face became completely paralysed. The spinal fluid withdrawn on the 10th day showed 60 cells, with the lymphocytes predominating. The spinal fluid was not found to be under increased pressure at any time.

From the 10th day to the 15th day, the patient's condition did not change to any noticeable degree, although the persistent headache was somewhat alleviated and he complained chiefly of the difficulty experienced in masticating.

On the 15th day the knee-jerks were normal and there was a marked improvement in the facial paralysis; and the improvement was constant, though gradual, until he was discharged on the 23rd day of hospitalization.

COMMENTS.—Encephalitis lethargica is an uncommon disease in the tropical regions of the Americas; and the author has found no reference in medical literature of it having become epidemic in any locality there.

Three cases have come to his attention during a period of 6 months. Two of the patients were not seriously ill; but the other had been ill for 2 months prior to the date he was seen by the author, and was the only one exhibiting symptoms of lethargy. The latter died in another institution, after an illness extending over several months; and the diagnosis of encephalitis lethargica was confirmed by postmortem examination.

### BAELZ'S DISEASE—A CASE REPORT

OTTO TIEMANN BROSIUS, M.D., D.T.M.&H., F.A.C.P.

United Fruit Company Hospital

Almirante, Panama

P. A., a married, native Panamanian negress, aged 30, came to the Out-Patient Clinic of the Almirante Hospital in August, 1926, to be treated for stomatitis; and tincture of benzoin was prescribed. The only other pathological condition found on physical examination and by laboratory tests was uncinariasis, for which she was treated with *Chenopodium*.

Later in the month, she was treated for tertian malaria. The stomatitis had not shown much improvement; but nothing abnormal was found on examination of smears from the gums, and Meinicke's test for syphilis was negative.

Her duties as a missionary were confined to the interior of the Republic, and she did not come under observation again until she returned to the Hospital in August, 1928, to be confined as a multipara.

In May, 1929, she again applied for treatment in the Out-Patient Clinic, and was suffering from a very severe attack of stomatitis and pyorrhea. At this time, smears from the mouth lesions showed many spirochaetes and fusiform bacilli; and the diagnosis of Vincent's angina was made. Accordingly, 4 doses of neo-



salvarsan, grams .6 each, were given at weekly intervals; but her condition did not improve under this treatment. She was then referred to the Herrick Clinic, in Panama; and the following report was subsequently received from their Dr. D. F. Reeder:

At a careful examination we found her to be suffering with the spirillum of Vincent's angina, as you had found. I treated her first with local applications of 606 applied around the teeth. Later, all the lower teeth and one upper tooth were extracted.

The trouble in her lip we diagnosed as cheilitis glandularis or Baelz's disease. This is a disease characterized by dilatation of the mucous glands of the lips. You will find this condition described in the "Principles and Practice of Dermatology," by Pusey. This is a very hard disease to cure. She is, however, now very much better. We are giving her x-ray treatments, but do not have much hope that we can effect a cure.

(signed) D. F. Reeder

## ARSENICAL DERMATITIS—WITH CASE REPORT

JOSE ALBERTO LOPEZ, M.D.

Truxillo Railroad Company Hospital

Puerto Castilla, Honduras

Occupational diseases are common in this industrial age. The etiological factors involved in most of the conditions so classified have been determined, and preventive steps have been taken to guard the worker. In most countries, these safeguards are enforced by law; although employers are generally eager to adopt any protective measures which will improve the health and, consequently, the efficiency of their employees.

Pure metallic arsenic is inoffensive; but the dusty arsenious acid (manufactured by roasting the ore and thus volatilizing the arsenic), and the salts and anhydride of arsenic, are lethal elements. It is recognized that Paris green, emerald green, and Schweinfurt green are very dangerous when dry and powdered.

The replacement of Scheele's green (copper arsenite) by aniline dyes in certain industries (dress goods, paper flowers, wall-paper) has eliminated the use of a poisonous substance which was responsible formerly for considerable morbidity among the workers. Before the passage of restrictive legislation, some brands of wall-paper contained as much as 60 grs. of arsenic per square foot, but, nowadays, 0.1 gr. per square yard is rarely exceeded.

Arsenic has a predilection for the lower motor neurons, and is more neurotoxic than lead as it attacks the sensory as well as the motor system. Its degenerative effect on the kidneys resembles that of mercury; while it causes pathological conditions of the liver similar to those produced by phosphorus or by the toxins responsible for acute yellow atrophy.

*Paris Green Used as a Larvicidal Agent.*—Paris green mixed with road dust,

saw dust, and other excipients has been used for several years on the Company's plantations for the purpose of preventing the breeding of anopheles mosquitoes. It has been noted that there is a difference in the arsenic strength of commercial preparations of Paris green purchasable on the market. The usual proportions of the mixture are 1 part of Paris green to 100 parts of the excipient. The mixing is usually done in a house or shed where there is protection from wind; and, in consequence, it is impossible for the worker to avoid getting a thin coating of the fine dust on exposed parts of the skin and inhaling a certain quantity of impalpable particles into the nose or mouth with each inspiration. The dust mixture may be applied to mosquito-breeding areas by various means; but in this locality it is customary for the worker to stand on the edge of the pool or ditch to be treated and cast handfuls of the mixture into the air, relying upon the force of the wind to distribute the dust and to carry it to all the areas which require treatment. Ordinarily, the worker exposes only the hand which applies the dust, as the wind carries the particles away from him and thus the face and body are protected.

Tho hundreds of pounds of Paris green have been used by the Company's Sanitary Personnel in the different Divisions, the use of the dust preparation has been considered harmless to the workers and the writer has found no reports of suspicious toxic symptoms developing among members of the sanitary forces who were engaged in mixing the preparation or applying it. For this reason, a case of arsenical dermatitis, which occurred in a member of the local sanitary squad occupied in the control of mosquito breeding with Paris green dust mixture, is hereby reported.

#### CASE REPORT

A. E., Honduran, aged 25 years, was admitted to the Hospital on August 17, 1929. He complained of intense itching of the face, neck, hands and forearms, swelling of the face and eyelids, and inflammation of the eyes.

*Previous History.*—His previous history was uneventful, except that he had been treated for specific urethritis 5 years previously. He had been employed as a laborer on the banana plantations up to three months ago, when he obtained a place on the sanitary squad engaged in malaria-control work. He had never suffered from skin disease prior to the present attack.

*Present History.*—The patient's work necessitated making a mixture of Paris green and road dust (1 part to 100), and broadcasting it by hand. The itching sensation on his face, hands and forearms had begun a short time before he presented himself at the Hospital, and got progressively worse. He was not aware of the cause, and did not feel any other ill-effects except that the skin condition did not permit him to get a proper amount of sleep. He stated that two of his fellow workers had suffered from the same affection, but to such a mild degree that they had not sought treatment.

*Physical Examination.*—The patient was a well nourished and well developed

mestizo. His face and neck were swollen, red and indurated, presenting small papules, a few pustules, and a slight degree of fine desquamation over the affected area. A similar condition was observed on the hands and forearms, extending to an inch above the elbows; on a narrow strip of the lower abdomen above the belt line, where the shirt was open and loosely adjusted; on both feet; and on the legs extending to 4 inches above the ankles. There were a few carious teeth, and the inguinal glands were palpable. The temperature was 99 degrees F.; urine, negative except for a few pus cells; blood, negative for malaria; Meinicke's blood test, negative for syphilis; and the stools were free from evidence of parasitic infestation.

*Treatment.*—The patient was purged with magnesium sulphate, and the skin condition was treated with calamine lotion, alternated with a soothing ointment.

*Result.*—At the end of the 3rd day, the swelling was completely gone; itching was slight; the patient rested well; the temperature was normal; and the general improvement in the appearance of the skin lesions was remarkable. On the 4th day, the patient insisted on leaving the Hospital as he considered himself entirely well. He was advised to obtain employment on the banana plantations, and not to rejoin the sanitary squad.

Four days later the patient returned to the Hospital with a severe recurrence of all the skin conditions. He had resumed duty with the sanitary squad, and had been assigned to making Paris green mixtures of greater strength than usual. There was an immediate response to the same medication used during the preceding period of treatment, and he was discharged on the 4th day as cured. He was instructed to return weekly to the Clinic for observation. He secured a post as watchman, and there has been no recurrence of the skin lesions to date.

#### SUMMARY AND CONCLUSIONS

(1) Due to more or less continuous exposure to the irritating affect of Paris green powder or to an idiosyncrasy toward the arsenic contained in Paris green, a member of the malaria-control squad developed a severe dermatitis of all exposed parts.

(2) An individual may remain immune for months; but later develop a severe dermatitis which will disappear, with little or no treatment, upon a change of occupation. It is possible that the condition develops subsequent to sensitization of the constantly irritated tissues—in other words, that it is a local cutaneous anaphylaxis.

(3) Constitutional symptoms may or may not develop, after repeated exposure.



## IMPROPER DIAGNOSIS BY A MEDICAL PRACTITIONER

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The practice of medicine has been a heterogeneous mixture of failures and successes; but the ratio between the former and the latter has gradually increased as the Present has profited by the errors of the Past. The number of failures have decreased, and the number of cases showing good clinical and therapeutical results have increased, due to the constantly accelerated progress of medical science which is a part of the natural inheritance of every medical practitioner. The knowledge obtained through our professors, and the experience gained through our professional practice, are an amalgam that leads to the highest degree of perfection.

This short article, dedicated to my fellow practitioners, has two objects: viz., to demonstrate the great benefit to be derived from utilizing all available laboratory aids in endeavoring to make diagnoses; and the necessity of confessing our failures to our colleagues, so that they may profit from our experience.

The article is compiled in such a manner that the reader may have an opportunity to agree or disagree with the diagnoses made, the clinical corrections, and the operative procedures; and to consider the postmortem findings which demonstrated the mistakes made and the reasons why they were made. If it impresses upon some of my young fellow-doctors the necessity of using all available resources of medical knowledge, in an endeavor to make a proper and complete diagnosis of each and every case; it will have served its purpose.

## CASE 1

*History.*—M. P., Guatemalan, 30 years of age, when he was admitted to the Hospital, complained of having had severe headache on the left side for 5 months. Six days prior to his admission he noticed an abnormal overflow of tears (epiphora) from the left eye, which he could not open completely as the upper eyelid remained half-closed. The patient gave no history of having had fever or any other symptoms than those mentioned.

Five years previously he had a chancre which lasted about 1 month. Two years ago, 2 cervical glands on the left side became inflamed and suppurated; but he recovered from the condition in 2 months.

*Physical Examination.*—The physical examination elicited the following:

*Nutrition.*—Very poorly nourished.

*Skin.*—Pale. Scars from suppurative adenitis were noted in the axillary, subclavian, left cervical, and mid-supraclavicular regions.

*Glands.*—Cervical, inguinal, axillary, and epitrochlear enlarged.

*Bones.*—Pain in the bones at night.

*Mouth.*—Left lingual paralysis, and decayed teeth.

*Eyes.*—Ptosis of the optic of the left eye, which had an irregularly dilated pupil.

*Lungs.*—Over the left apex and extending downward, friction murmurs and moist râles were heard.

*Heart.*—Paroxysmal tachycardia, with pulsations too rapid to count.

*Nervous System.*—Romberg's sign, negative; Argyll-Robertson pupils; abdominal reflex, positive; left cremasteric reflex, negative; patellar reflex, positive.

*Laboratory Findings.*—The laboratory examination at the time of admission showed: urine, negative; stool, *Trichocephalus dispar* ova; blood, negative for malaria parasites.

*Tentative Diagnosis.*—The tentative diagnosis was "Ocular manifestation of syphilitic origin, local or central;" and anti-syphilitic treatment was instituted but no progress was made.

*Clinical Corrections.*—On further examination the sputum proved positive for Koch bacilli; and, furthermore, though he had received no anti-syphilitic treatment, the Meinicke test for syphilis was negative. The roentgenograms showed calcified areas in both pulmonary apices, and enlargement of the tracheobronchial glands. These findings clarified the diagnosis. The pupillary dilation, the left lingual paralysis, and the paroxysmal tachycardia are all evidences of the mechanical compression and irritation of the branches of the spinal trigeminus, ciliary and vagus nerves which are in topographical relation to the cervical and tracheobronchial glands.

*Final Diagnosis.*—Tuberculosis of the lungs, and of the cervical and tracheobronchial glands.

*Result.*—The patient was discharged from the Hospital 3 days after admission, with the advice that he take treatment at home for tuberculosis.

*Comments.*—In this case, on his admission to the Hospital, I omitted to make the examination of the sputum, the Meinicke's blood-serum reaction, and the roentgenological examination—all of which were necessary in order to make a good primary diagnosis, as the Meinicke test was negative; the sputum, positive for Koch bacilli; and the roentgenological examination showed slight caseation in the pulmonary apices and enlargement of the tracheobronchial glands.

## CASE 2

*History.*—T. M., Guatemalan, 22 years of age, was struck on the right shoulder by a rail, while working on the railway line 6 days before his admission to the Hospital.

*Physical Examination.*—There was slight inflammation in the right shoulder and clavicular region, associated with pain which prevented complete movement of the arm (rotation and elevation). An examination of the lungs proved negative.

*X-ray Examination.*—Bones, articulations, and lungs were negative.

*Laboratory Findings.*—Urine, negative; stools, *uncinaria* ova; blood, negative for parasites; Meinicke's reaction positive for syphilis; white blood-count 9,000.

*Tentative Diagnosis.*—Contusion on shoulder, complicated with syphilis.

*Clinical History.*—The temperature was normal in the morning; but in the afternoon and evening increased to between 100°F. and 102°F., usually reaching the highest point at 4:00 p.m. Respiration was normal. The pulse fluctuated between 72 and 104, without any pathological characteristics.

*Treatment.*—Iodides, mercury, salvarsan, quinine sulphate, oil of chenopodium, and salicylates were administered as indicated. Ice bags and packings of gauze saturated with a solution of magnesium sulphate were applied locally. This treatment was followed for 11 days; but at the expiration of that period of time I decided to make an incision down to the inner aponeurosis of the trapezius muscle in search of an abscess, which I failed to find.

*Clinical Correction.*—Inasmuch as I did not obtain results from the exploratory incision down through the trapezius muscle, I used an exploratory needle and found a localized suprascapular abscess which was drained. The temperature was immediately controlled, and the patient made an uneventful and complete recovery.

*Result.*—He was discharged from the Hospital 21 days after the operation.

*Final Diagnosis.*—Suprascapular abscess of traumatic origin.

In this case I would have made a serious error if I had not made the further exploration.

### CASE 3

*History.*—D. S., Guatemalan, male, 23 years of age, when he was admitted to the Hospital stated that he had suffered from chills and fever, headache, backache, and nausea, for 18 days. For the last 12 days he had been treated for malaria, at a Field Dispensary, with plasmochin and quinine; but without relief. On admission his temperature was 101°F. and pulse, 106.

*Physical Examination.*—The patient was poorly nourished and dehydrated. His skin was blanched; tongue, dry with red border; and eyes, sunken. Soft systolic blows were perceptible over the entire precordial region; the spleen was palpable for a distance equal to the breadth of 4 fingers below the umbilical line and at internal border of the left rectus, and was very tender on pressure; the liver was slightly tender and somewhat enlarged; abdomen showed slight succussion in the right inferior quadrant, but was otherwise negative.

*Laboratory Findings.*—Urine, negative; stools, negative; blood, negative for malaria parasites; leucocyte count 7,500; hemoglobin 40%.

*Tentative Diagnosis.*—*Clinical malaria*; inasmuch as the blood was negative for malaria parasites, which was presumably due to the quinine taken before admission.

*Clinical History.*—*First Day.*—Temperature was 101°F. and pulse rate was 106 at 4:00 p.m., when the patient was admitted. He was given 10 drops of adrenalin solution 1:1000 immediately, and 20 minutes later 10 grains of qui-



nine dihydrochloride—both, hypodermically. As his pulse was weak and poor in volume,  $\frac{1}{40}$  gr. strychnine was administered every 4 hours.

*Second Day.*—The following temperatures and pulse rates were recorded at 4-hour intervals: T. 100°F., P. 110; T. 99°F., P. 94; T. 101°F., P. 100; T. 103°F., P. 92; T. 102°F., P. 100; T. 100°F., P. 88. His bowels moved 4 times; which, at this time, I did not consider of any importance. Also, the patient vomited a reddish liquid such as is occasionally seen in cases of malaria of the hemorrhagic type. I noted a little agitation and discomfort on the part of the patient, who refused his liquid diet consisting of milk, beef broth, and egg-nogs. Adrenalin and quinine medication was continued; and, because of the mental and other symptoms he was given 15 gr. of sodium bromide, 20 gr. sodium bicarbonate, and 20 gr. bismuth subnitrate, b.i.d., by mouth. A hypodermoclysis of 800 c.c. of physiological salt solution was administered; and also  $\frac{1}{4}$  gr. of morphine, hypodermically. With this treatment, I expected to control all of the abnormal conditions present in the patient.

*Third Day.*—The temperatures and pulse rates, taken at 4-hour intervals, were somewhat higher—T. 98°F., P. 80; T. 102°F., P. 132; T. 102°F., P. 120; T. 103°F., P. 132; T. 99°F., P. 118. The pulse was weaker and of less volume, from the middle of the day on. The blood was reexamined for parasites, but was found to be negative. The patient's bowels moved once during the night. In the morning he vomited about 10 ozs. of a greenish-colored fluid containing bile and blood. In the evening, he vomited a brownish colored liquid, containing a large quantity of blood. Adrenalin and quinine were given in the same form as in the previous days, but the quinine dosage was increased 15 gr. b.i.d. Furthermore, he received camphor oil, 2 c.c. every 4 hours; a hypodermoclysis of 1,000 c.c. of physiological salt solution morning and evening; calcium lactate, 10 gr. t.i.d. Sodium bromide and bismuth were discontinued. A diet of gelatin ad libitum was prescribed; and the application of hotwater bottles and blankets was ordered.

*Clinical Correction.*—The temperature, pulse, and vomiting, and the general collapse of the patient during the later hours of the last day, pointed to an intestinal perforation associated with typhoid fever. However, the proper diagnosis was determined too late for surgical interference, as it was made just half an hour before the patient died at 7:45 p.m.

*Postmortem Findings.*—A postmortem was performed by our pathologist, Dr. G. R. Harrod, who reported: Typhoid fever; perforation of the ileum near the ileocecal valve; general peritonitis; enlarged liver and spleen; acute nephritis; and acute hemorrhagic gastritis. Our final diagnosis of typhoid fever was confirmed by Dr. F. B. Mallory, of the Boston City Hospital.

*Comments.*—In this case I made a grave mistake in not taking advantage of the laboratory facilities. Notwithstanding the history of the patient, the enlargement of the spleen, the fact that he resided in a malarial district, and the almost absolute absence of typhoid and paratyphoid fevers in this zone; I should have considered the possibility of typhoid fever because of the normal leucocyte

count of the patient, the typical typhoid tongue, and the continuous fever which did not yield to quinine treatment given for 12 consecutive days in conjunction with a course of plasmochin. I overlooked the significance of the pain extending from the hepatic region to the right inferior quadrant of the abdomen, where I noted the intestinal succession; and disregarded the numerous fecal evacuations of the patient. I did not make repeated leucocyte counts which perhaps would have been subnormal at times; I did not look for parasites in blood specimens taken at different hours during the day; and, finally, a blood culture and a Widal's test were not made.

In future, I shall never be satisfied with the diagnosis of a case until I have made a complete and conscientious examination of all organs, and have taken advantage of all possible laboratory and x-ray findings.

#### CASE 4

*History.*—M. G., Guatemalan, 26 years of age, female, was injured by gunshot 3 hours prior to her admission to the Hospital. The wound of entrance was over the left renal region, and there was no exit wound.

*Physical Examination.*—On admission the patient's temperature was 99°F.; pulse was 120, weak, and of small volume; respirations, 44 per minute. She appeared toxic. Her general condition was fair; no vomiting nor nausea was present; her bowels moved once; and she voided blood-stained urine twice the following morning. There was abdominal pain on pressure in the hepatic region and extending down to the right lower abdominal quadrant, and muscular rigidity over the right lumbar region; and both renal regions were painful upon pressure, although apparently the more acute in the right than in the left. X-ray examination did not reveal sufficient information to make a correct diagnosis, as it showed only the shadow of the bullet in the region of the right kidney.

*Laboratory Findings.*—The urinalysis was positive for albumin and blood; stool was negative; blood was negative for parasites.

*Tentative Diagnosis.*—Perforation of the left kidney, and of the abdominal organs (probably the liver).

*Treatment.*—Exploratory laparotomy—exploration of the left kidney.

*Clinical Correction.*—A medical consultant made the diagnosis of perforation of the left kidney, and the abdominal organs (probably the spleen); but it was my belief that there was perforation of the right kidney and retroperitoneal hemorrhage over the right side.

The course of the bullet (insofar as I could determine it by inserting a flexible sound through the superficial muscles) was from behind, forward; and from left to right at a very acute angle. The pain in the left renal region was localized solely in the superficial muscles; but palpation over the anterior and lateral regions of the left kidney was painless. The right renal region was painful on pressure. The bladder presented no pathology other than the hematuria.

Based on this superficial clinical information, I made the diagnosis of perfora-

tion of the right kidney; which, however, proved to be correct. The other part of my diagnosis was also correct and was based on the belief that, the kidney being injured, an extrarenal hemorrhage was produced, in addition to the endorenal hemorrhage which caused the hematuria. Moreover, no acute abdominal symptoms were presented which were referable to the involvement of other organs; as 13 hours had passed since the accident, and muscular rigidity was present only in the right renal region.

*Further Treatment and Final Diagnosis.*—The operation verified the diagnosis. The inferior pole of the right kidney was perforated and there were perirenal and retroperitoneal collections of blood. We performed a right nephrectomy (which was not justified); cleaned the region, washing off the coagula with saline solution; located and extracted the bullet; and drained the operative wound.

*Result.*—The patient recovered without any further untoward incident, and was completely well when discharged 25 days after the operation.

*Comments.*—In this case I made a great mistake by not using well-known and available diagnostic aids. Every practitioner who performs a nephrectomy (except in cases of great emergency), without first testing the functional activity of the other kidney, neglects an important step in technique; and he who makes a diagnosis of rupture of a kidney, without first catheterizing the ureters or at least making a cystoscopic examination to find out the source of hemorrhage, is exposing himself to justifiable criticism. Neither is it good surgical judgment to remove an organ when it is possible to save it. In cases of perforation of the inferior pole of the kidney, a repair operation is indicated and not a nephrectomy.

#### CASE 5

*History.*—O. W., a negro from British Honduras, 39 years of age, stated on admission to the Hospital that he had been suffering from fever, headache, backache, anorexia, and constipation, for 3 weeks.

*Physical Examination.*—On the day of admission to the Hospital, the temperature was 101°F., and the pulse rate, 100. The patient was tall, and well-developed, but emaciated. His tongue was dry and had a markedly red border (typhoidal); eyes were sunken; lungs were negative; liver was painful on pressure, especially over the region of the gall bladder; spleen was palpable, and painful on pressure. The two lower abdominal quadrants were painful on pressure; and intestinal succussion was present. Rectal examination revealed the presence of hemorrhoids. The nervous system exhibited symptoms of mild delirium.

*Laboratory Findings.*—The urine was negative; the stools showed blood and pus; blood was negative for malarial parasites; white blood-count, 7,500; hemoglobin, 60%; and Meinicke test for syphilis, negative.

*Tentative Diagnosis.*—Clinical malaria, and external hemorrhoids.

*Clinical History.*—Quinine and plasmochin treatment was instituted. For the first 2 days the temperature ascended progressively up to 102°F. on the 2nd day.



The morning of the 3rd day it was normal; but rose again up to 101°F. at noon; and it continued to rise gradually during the following 8 days, with slight morning remissions, until the 8th day when the patient died with a temperature of 105°F.

The blood was examined repeatedly during the course of treatment, with negative findings for malaria parasites. Nevertheless quinine and adrenalin were administered hypodermically, (despite favorable results), as I consider this therapeutic combination infallible in cases of obstinate malaria when quinine alone fails to control the temperature. The pulse rate rose and decreased with the fluctuations in temperature, and ranged from 80 to 103. The patient evacuated stools 2 or 3 times daily. On the 6th day, delirium was acute; and it was necessary to restrain the patient in bed, and to administer bromides, morphine, etc.

*Clinical Correction.*—I changed my diagnosis to that of typhoid fever, and the treatment indicated for that disease was instituted. The patient died 11 days after admission.

*Postmortem Findings.*—Our pathologist, Dr. G. R. Harrod, performed a post-mortem and reported as follows: Tuberculous meningitis, widely disseminated (especially over the frontal lobes); sclerotic kidneys; and chronic colitis of the entire colon.

*Comments.*—It is a very censurable failure on the part of a physician to make a diagnosis of typhoid fever, based on the clinical symptoms and physical examinations alone; when he is in a Hospital equipped with all facilities for the agglutination of blood and for cultures and neglects to use them.

## CASE 6

*History.*—M. R., an Indian, 28 years of age, had left the Hospital apparently well 11 days previously, after a stay of 7 days for treatment of tertian malaria with quinine and plasmochin. The night before his present admission he felt a sudden and severe pain in the abdomen.

*Physical Examination.*—The patient was admitted to the Hospital at 9:00 a.m., with a temperature of 101°F. The pulse rate was 134, weak, and of small volume. He complained of feeling chilly; the skin was pale and cold, with profuse perspiration; and the eyes were sunken. The abdomen was sensitive on pressure; distended; and with slight muscular rigidity, especially over the splenic region. The liver was slightly enlarged, and sensitive to pressure. The spleen was enlarged, extended down to the umbilical line, and was very sensitive to pressure. The heart was rapid.

*Laboratory Findings.*—Urine was negative; stool was positive for pus and mucus, and uncinaria ova; blood was negative for malarial parasites; white cell count was 12,250.

*Immediate Treatment.*—He was given immediately morphine,  $\frac{1}{4}$  gr.; strychnine,  $\frac{1}{10}$  gr.; 10 drops of adrenalin solution (1:1000) hypodermically; and 15 grs. of

quinine dihydrochloride intramuscularly. An hour after admission he received an injection of 2 c.c. of camphor in oil.

*Clinical Correction.*—The sudden pain, pulse rate, temperature, and abdominal symptoms pointed to an acute abdominal condition; but there was lack of vomiting, although the pain had begun more than 12 hours previously.

What was the diagnosis—nephritic colic; or hydronephrosis; or hepatic rupture; or splenic rupture; or acute torsion of the spermatic cord; or injury of the pancreas; or malaria with abdominal symptoms?

I made a needle puncture in the abdominal cavity over the inferior left quadrant, and obtained venous blood with each respiratory movement.

*Diagnosis.*—Intra-abdominal hemorrhage, probably due to a spontaneous rupture of the spleen.

*Further Treatment.*—Exploratory laparotomy was indicated, and this was performed after preparing the patient for a transfusion with the blood collected from the abdominal cavity. An extensive rupture of the spleen was found. Hemorrhage was no longer active, but more than 2 liters of blood were found in the abdominal cavity. As much blood as could be collected from the abdominal cavity was transfused; but, unfortunately, the heart failed and all efforts to prevent collapse were unavailing.

*Result.*—The patient died almost immediately after the splenectomy operation was completed.

#### CASE 7

*History.*—M. R., female, 21 years of age, was admitted to the Hospital at Port Limon (Costa Rica), 7 years ago. The diagnosis of abortion was made by the physician attending the patient at her home. She gave a history of having had metrorrhagia, accompanied by uterine pains, at intervals of a few hours for 15 days. She had been married 3 months and had missed 2 menstrual periods. Her pulse and temperature were normal. A vaginal examination revealed a soft and slightly dilated cervix, and metrorrhagia. On bimanual palpation the size of the uterus was found to correspond with that of a 2 months pregnancy; and there was also a tumor mass, about the size of the uterus, located in the region of the left adnexa, and painful on pressure.

*Diagnosis.*—Extra-uterine pregnancy; or hemorrhagic metritis and left salpingitis.

*Clinical Correction.*—The abdominal skin over the region of the tumor showed a slight bluish tint, similar to that of a hemorrhagic discoloration sometimes produced by an injection in a person having very white skin. My diagnosis, and that made by Dr. Montealegre who assisted me in the case, was a ruptured tubal pregnancy of the left side.

*Treatment.*—I did a uterine curettage, with negative results; and afterwards performed a laparotomy and left salpingectomy. The oviduct had ruptured; and the fetal ovum was found in the abdominal cavity, covered with a blood clot and forming a coherent mass with the oviduct.

*Result.*—The patient recovered and she was discharged 18 days after the operation.

*Comments.*—This instance demonstrates that all cases of metrorrhagia with similar histories should not be attributed invariably to intrauterine fetal separations, and that they should receive more conscientious investigations than the routine methods followed by some practitioners.





PARK MAINTAINED BY THE TRUXILLO RAILROAD COMPANY FOR EMPLOYEES AND THEIR FAMILIES, IN  
PUERTO CASTILLA, HONDURAS



ONE OF THE RESIDENTIAL STREETS FOR FIRST-CLASS EMPLOYEES AND THEIR FAMILIES IN PRESTON, CUBA



RESIDENCES OF FIRST-CLASS EMPLOYEES ON THE CHOCTAW FARM IN THE GUATEMALA DIVISION





RESIDENCES OF FIRST-CLASS EMPLOYEES IN THE MOTAGUA DISTRICT OF THE GUATEMALA DIVISION



CLUB HOUSE FOR EMPLOYEES OF THE CHIRIQUI LAND COMPANY, PANAMA



CLUB HOUSE FOR EMPLOYEES OF THE TRUXILLO RAILROAD COMPANY, HONDURAS





BACHELORS' QUARTERS FOR EMPLOYEES OF THE TRUXILLO RAILROAD COMPANY, HONDURAS



FRONT VIEW OF FOUR-FAMILY HOUSES FOR EMPLOYEES OF THE CHIRIQUI LAND COMPANY, PANAMA



REAR VIEW OF FOUR-FAMILY HOUSES FOR EMPLOYEES OF THE CHIRQUI LAND COMPANY, PANAMA





AMERICAN NURSES' QUARTERS—TRUXILLO RAILROAD COMPANY HOSPITAL, HONDURAS



TENNIS-COURTS FOR EMPLOYEES OF THE CHIRQUI LAND COMPANY, PANAMA



GOLF-COURSE AND RECREATION GROUNDS FOR EMPLOYEES OF THE PRESTON DIVISION, CUBA





FARM OVERSEER'S HOUSE IN THE TRUXILLO RAILROAD COMPANY DIVISION, HONDURAS



FARM "BATEY" IN THE PRESTON DIVISION, CUBA



TYPICAL CAMP FOR FARM LABORERS AND THEIR FAMILIES IN THE GUATEMALA DIVISION





### GARDEN PLOT OF AN EMPLOYEE'S FAMILY IN THE BANES DIVISION

YOUNG TREES AND VEGETABLE SEED ARE FURNISHED BY THE COMPANY, AND THE GROUND IS PLACED IN CONDITION FOR PLANTING

## SECTION IV

## AN UNUSUALLY LARGE MIXED TUMOR OF THE PALATE

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## PRELIMINARY REMARKS

According to Lenormant, though mixed tumors of the palate are very rare, they are the type most frequently found in this region. They occur between the 20th and 60th years of age; and Eisenmerger, who collected 76 cases, found them to be about equally distributed between the sexes—37 in males and 39 in females.

The tumors usually occur on the velum, at the junction of the hard and soft palate; and appear as single, rounded, encapsulated, laterally situated masses made prominent by the contraction of the soft palate. They sometimes grow to be the size of a hen's egg. When palpated, they are rather hard and movable. They do not invade the bones; and are rarely anchored to them, though they may become attached to the tissues of the pterygomaxillary fossa, or to those of the parotid region. They grow very slowly for years—sometimes as long as 40 years—and usually come to the attention of the surgeon with a history of long existence followed by sudden recent enlargement. Their location makes it impossible for them to reach any large degree of size before they cause so much discomfort as to necessitate removal, which probably explains why they are usually said to be benign (1).

The author has considered the following case worth reporting, in view of (a) the rarity of this type of tumor, (b) the unusual size of the tumor found by the surgeon, and (c) the satisfactory surgical results attained.

## CASE REPORT

J. F., white, male, Cuban, 72 years of age, when he was admitted to the Hospital, complained of a large tumor in his mouth which interfered considerably with his speech, and made it difficult for him to swallow solid food.

*History.*—Ten years ago he first noticed a tumor, about the size of an orange seed, in the middle of his palate. It did not annoy him in any way, until three years ago when it began to grow rapidly; and caused a slight mechanical obstruction. He did not consult a surgeon until it grew to the size of a small lemon, when he went to Santiago de Cuba where the condition was diagnosed as a sarcoma. He was informed that an operation was inadvisable and was given the prognosis of a fatal termination within the following six months. Two years later, however, the man was still alive and felt well except for the natural discomfort caused by the tumor mass. Other personal and family history was irrelevant.

*Physical Examination.*—The patient was a poorly nourished adult male, but showed no signs of cachexia.

*Mouth.*—The oral cavity was almost completely occupied by a hard and somewhat nodular tumor. The mass extended posteriorly into the pharynx,



FIG. 1

and showed an area of softening in the center which had not ulcerated. It was attached to the palate by a very broad and short pedicle, but apparently there was no direct connection with the bone. The surrounding areas were not involved in the tumor mass, and the air passages were free (Fig 1).

*Operation.*—Rectal anaesthesia, with ether and oil, was given according to the technique of Gwathmey. The location of the tumor, and the bleeding which was



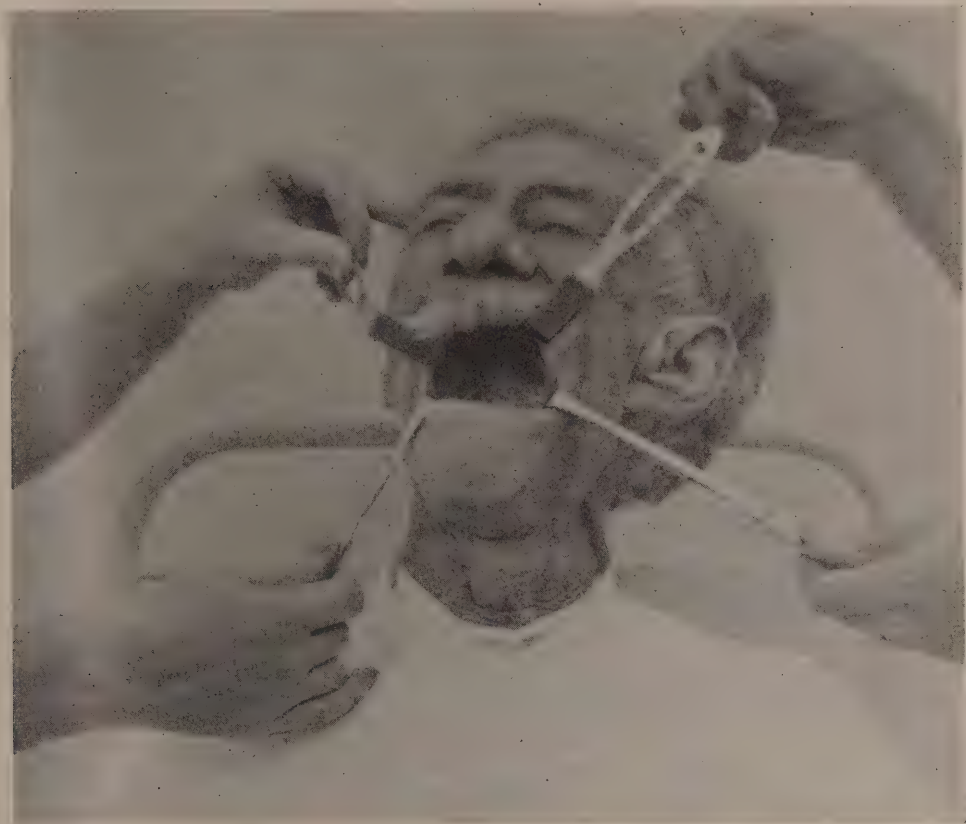


FIG. 2

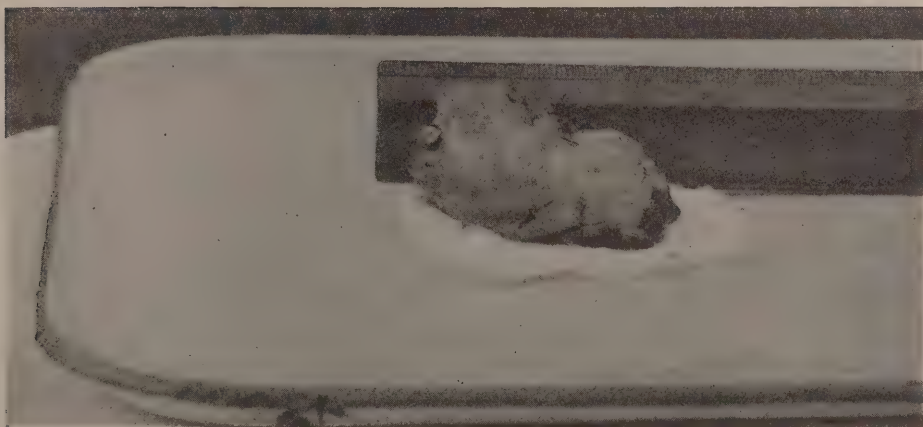


FIG. 3

to be expected, necessitated a rapid operation. The patient was put in the Trendelenburg's position to avoid bleeding into the trachea. A Gigli saw was hooked around the pedicle; and, with a to-and-fro motion, the tumor was cut very rapidly and close to the bone. Bleeding was controlled by hot packs, followed by the immediate ligation of the main blood vessels. The surface oozing was curbed by a thermo-cautery.

*Results.*—The patient had an uneventful convalescence; and was discharged on the seventeenth day after the operation, at which time the process of healing was far advanced (Fig. 2).

The tumor was photographed after it was extirpated, and is shown in Fig. 3.

*Pathological Examination.*—The pathological report received from Dr. F. B. Mallory is quoted verbatim below:

Clinical diagnosis: Tumor palate.

Microscopic examination shows a cellular tumor covered on one side by a layer of squamous epithelium. The tumor cells are arranged in clumps and anastomosing strands. In places they differentiate into squamous epithelium and form epithelial pearls. The stroma varies considerably in amount. It appears more or less hyaline due apparently to edema and separation of the collagenous fibrils. Peripherally the tumor is cellular; centrally many of the cells have died off and the stroma is relatively greatly increased in amount. Although the tumor seems to be entirely of an epithelial nature it does not appear like the ordinary epidermoid cancer. The best diagnosis is probably mixed tumor of the parotid gland type. There are many pyknotic nuclei but no mitoses were noted. The prognosis is favorable provided all of the tumor was removed.

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## LUMBAR AND SACRO-ILIAC PAIN AND ITS RELATION TO DISEASE OF THE PELVIC VISCERA

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When a patient seeks medical advice for a disease which causes pain to be referred to the anterior abdominal wall, he is rarely treated symptomatically. It is considered that this patient has one of the many serious diseases which might possibly cause pain in this region, and very definite steps are taken to establish a diagnosis. Yet, when a patient seeks advice for a condition that causes pain to be referred to the lower lumbar or sacro-iliac region, his case will in many instances be recorded as "another patient with backache". Then, too, the patients often are only too willing to minimize their illness and agree that their condition

is rheumatic, or due to a sacro-iliac strain. The gynecologist, the urologist, and the orthopedic surgeon recognize the value of this symptom, and endeavor to relieve the patient by seeking and correcting the pathological condition causing it.

The writer does not presume to give the differential diagnoses of diseases of the pelvic viscera, nor to suggest the treatment for any of the conditions; but merely desires to review the more common conditions with which lumbar or sacro-iliac pain is associated.

Patients with lumbar and sacro-iliac pain are listed under many different diagnoses. The most popular of these is lumbago. Lumbago is defined as "*rheumatism of the tendinous attachments of the muscles of the lumbar region*". Rheumatism is defined as "*an indefinite term applied to various conditions characterized by pains in the muscles, joints, and fibrous tissues.*" Myalgia and myositis are frequent excuses for the administration of salicylates to relieve sacro-iliac and lumbar pain. Some few select cases are rewarded with a diagnosis of sacro-iliac synchondrositis. Considering the comparative rarity of the above conditions and the vague definition of disease which they offer, these diagnoses are justifiable only after exclusion of all other conditions which might account for the symptoms. Sacro-iliac strain, and disease of the pelvic bones or joints in this region can be diagnosed usually by the history, local findings, and x-ray evidence. The history, however, is not always reliable, as many patients will attribute their first pain from pelvic visceral disease to some unusual exercise performed about the same time that the pain was first experienced. Definite injury to the sacro-iliac joint can be determined easily. If there is injury to the anterior sacro-iliac ligament, the pain is increased by inward pressure over both buttocks in an attempt to approximate the posterior iliac spines, as this manipulation places tension on the injured ligament; and, if the posterior ligament is injured, the pain is diminished by this maneuver, which relaxes the tension on the injured ligament. A similar test may be applied by attempting to approximate the anterior iliac spines, which results in a diminution of the pain from anterior ligament injury, while causing an intensification of the pain if there is injury to the posterior ligament. If the pain is not affected by either maneuver, no injury to the sacro-iliac ligaments has been sustained.

Pain in the lower lumbar and sacro-iliac region which is not due to bone, joint, or muscle injury or disease, is dependent on the spinal connections of the sympathetic nerve fibers which supply the pelvic viscera and peritoneum. The aortic sympathetic plexus, which is the continuation downward of the coeliac plexus around the abdominal aorta, is continued into the pelvis as the hypogastric nerves which unite over the sacral promontory to form the hypogastric plexus. The hypogastric plexus divides and extends downward into the pelvis on each side of the rectum to form the two pelvic sympathetic plexuses. Accompanying the hypogastric artery and its branches, each pelvic plexus gives off subordinate plexuses for the pelvic viscera. All pelvic viscera are supplied thru



these connections; with the exception of the ovaries, fallopian tubes, and broad ligaments, which receive their nerve supply direct from the aortic plexus by means of fibres which accompany the ovarian arteries to the pelvis. The upper part of rectum, also, is supplied direct from the aortic plexus thru the fibres accompanying the inferior mesenteric artery. The external genitalia of both male and female have peculiar nerve connections, but they will not be considered here.

The afferent impulses from the uterus reach the spinal cord thru the 10th, 11th, and 12th thoracic; the 1st lumbar; and the 2nd, 3rd, and 4th sacral, segments. It is possible, therefore, for uterine pain to be referred to any of these segments; but it is unusual for pain to be referred above the lower lumbar segments. It seems probable that the degree of stimulation of the afferent nerves from the uterus plays some part in the location of the referred pain. Thus, the pain of a retroverted or retroflexed uterus, probably due to circulatory disturbance in the organ, is usually referred to the sacral vertebrae. The initial activities of the gravid uterus, a few hours before apparent labor contractions have begun, very frequently cause referred pain as high as the 3rd and 4th lumbar segments. This irritation should certainly be more severe than that of the uterus in malposition. The next in degree of severity of irritation is that seen in the acute infections of the endometrium; which frequently causes a reference of pain to the higher segments of the uterine spinal connections—the 1st lumbar and lower thoracic—which results in pain being felt in the lower portion of the anterior abdominal wall. This pain is separate and distinct from that of local suprapubic tenderness of the underlying inflamed and involuting uterus.

The afferent impulses from the fallopian tubes reach the spinal cord thru the 11th and 12th thoracic and 1st lumbar segments. These nerve connections account for the acute abdominal symptoms referable to the anterior abdominal wall which are presented in cases of acute disease of these structures. However, as Graves points out, the really sensitive structure of the pelvis is the peritoneal covering of the viscera and pelvic wall. Consequently, a spreading infection from the fallopian tubes may cause referred pain from contiguous structures. This occurs, either in acute inflammatory disease when the peritoneum is irritated by the inflammatory exudate, or in chronic adhesive inflammatory conditions where the uterine tube is adherent to other structures. This reference of pain from involved contiguous structures also occurs in disease of the ovaries, whose afferent impulses reach the spinal cord thru the 10th thoracic segment. It is therefore possible, when the peritoneum of the uterus or posterior pelvic wall is involved in tubo-ovarian disease, for the pain to be referred to the lower lumbar and sacro-iliac region; although the lowest spinal connection of the afferent nerves of fallopian tubes or ovaries is the 1st lumbar segment.

The urinary bladder sends afferent impulses thru the pelvic plexuses to the 1st and 2nd lumbar and 3rd and 4th sacral segments. However, it is unusual for bladder conditions to cause referred pain to these segments. Disease in this region usually results in urinary distress and pain localized in the bladder. The

same is true for rectal conditions. Although the lower part of the rectum has nerve connections with the 2nd and 3rd sacral segments of the spinal cord, symptoms of disease in the rectum are usually entirely local.

In the male, the prostate gland and seminal vesicles are frequently the sites of inflammation. The afferent impulses from these viscera pass thru the pelvic plexuses and enter the spinal cord in the sacral segments (variable, from 2nd to 4th). Practically all patients with inflammation of the prostate gland or seminal vesicles have referred pain over the sacro-iliac region. The very acute cases present more urgent symptoms locally thru the rectum and perineum, but the patient with the sub-acute or chronically inflamed prostate gland or seminal vesicles nearly always complains first of sacro-iliac pain.

During the months of October and November, 1929, 51 patients, whose first and only complaint was pain in the lumbar or sacro-iliac regions, came to me.

Of these 51 patients, 12 were women, all of whom had either a malposition of the uterus or a chronic inflammatory condition of pelvic viscera. Of these 12 gynecological patients, 10 had been diagnosed previously as "lumbago" or "sacro-iliac strain" and treated with various anti-rheumatic mixtures.

Of the 39 men, one case showed no pelvic disease, but was an old man with tertiary syphilis, showing a blood Meinicke reaction of "three plus". Two other cases had no demonstrable pelvic disease, and their blood examinations for syphilis were negative. They probably had, as most of these patients claim to have, an actual muscle or joint strain in the lumbar or sacro-iliac region, though no such condition was evident at the time of examination. All of the remaining 36 cases had a sub-acute or chronic prostatitis, seminal vesiculitis, or both. Of these, 12 cases had been diagnosed previously as lumbago, myalgia, or sacro-iliac strain; and two cases had been diagnosed as sacro-iliac synchondrositis.

All of these cases of prostatitis or seminal vesiculitis have been treated by local measures alone, and all have either improved or have received complete relief from their pain. No drugs were used for diminishing the pain.

Lumbar and sacro-iliac pain, though not resulting in complete incapacity to work, is a symptom which causes much discomfort and decreases the patients' ability to attend properly to their duties. If it was usually the result of an obscure disease requiring highly specialized work in diagnosis, these cases would be difficult to manage, and they would be neglected except in the hands of the specialist. Fortunately, the correct diagnosis can be obtained in most cases by thorough rectal and vaginal examinations. It is much more satisfactory to do this, and institute the proper treatment, than to have these patients always with us with their ever present backache.

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A CASE OF CARCINOMATOUS DEGENERATION OF STOMACH  
ULCER

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Clean cut cases which substantiate the claim that carcinomatous changes occur in chronic gastric ulcers are not often encountered.

According to Delafield and Prudden,<sup>1</sup> opinions are still at variance as to the interpretation and relative frequency of changes suggesting carcinoma in chronic peptic ulcers. The question, they state, must be settled by the observation of surgical material; because at the time of autopsy it is difficult or impossible to differentiate an extensive ulcerated carcinoma from an ulcer with carcinomatous changes, and hence hard or impossible to determine whether or not the growth began primarily as an ulcer. Some believe, according to MacFarland,<sup>2</sup> that the carcinoma is ingrafted upon or develops from the ulcer; while others contend that a small carcinoma is attacked by the gastric juice and destroyed to the extent of leaving an ulcer.

## CASE REPORT

T. M., a white, Cuban, 50 years of age, laborer by occupation, when he was admitted to the Hospital, stated that he had been suffering from more or less constant pain in the epigastric region. He asserted that it was relieved momentarily by the intake of food, or by alkaline medications; and, more recently, by vomiting—self provoked on many occasions. He had lost considerable weight and felt very weak.

*Past History.*—The patient gave a history of stomach trouble, which had persisted for the preceding three years. The principal symptoms were indigestion, flatulence, constipation, and occasional pains in the epigastrium. He had been under medical treatment on several occasions, and had gotten some relief each time; and in one instance all symptoms disappeared, but recurred later with greater intensity.

*Dietetic History.*—For those of us who are convinced of the importance that diet plays in these lesions; it is of interest to know that this man has been a very heavy eater all his life, and that the food consumed has been practically restricted to a diet of refined cereal carbohydrates and proteins. In other words, he has lived on a diet of acid ash foods, which contained practically no vitamins. It consisted chiefly of polished rice, white bread, all kinds of sweet foods and drinks, coffee, meat in large quantities; and he very seldom ate green vegetables or fruits. The patient had lost practically all his teeth; and those left were decayed and showed pyorrhea alveolaris. There was no history of hematemesis; but he had noticed, on several occasions, tarry stools. Other personal and family history was irrelevant.



*Physical Examination.*—The patient was a poorly nourished, anemic-looking male adult, seemingly about 55 years of age; with conjunctivae slightly jaundiced and slight tenderness on pressure over the epigastric region, but exhibiting no other abnormal conditions.

*Laboratory Findings.*—Meinicke reaction for syphilis was negative; hemoglobin, 50%; red blood cell count, 3,550,000; blood smear for malaria, negative; and urinalysis, negative.

*Diagnosis.*—Chronic ulcer of stomach.

*Pre-operative Treatment.*—The man was put on a well-balanced soft diet, consisting of fruit juices in large quantities, butter, cheese, milk, soft-boiled eggs, mashed potatoes, strained vegetable and bean soups; and, as medication tincture of belladonna, and alkalies in the form of sodium bicarbonate and bismuth were administered. All decayed teeth were removed. After fifteen days of such treatment the man had improved considerably.

*Operation.*—He was given local and spinal anaesthesia, supplemented by ether. Exploration revealed a callous ulcer, about  $1\frac{1}{4}$  inches in diameter, situated in the pyloric region. A trans-mesocolic partial gastrectomy of the Polya-Mayo type was performed, removing two-thirds of the stomach. The gall-bladder was full of calculi and showed many peri-vesicular adhesions; and, consequently, was removed.

*Result.*—The man remained in the Hospital for two months after the operation; and was kept on a proper diet and thoroughly instructed concerning the dietetic regimen which he should follow. He gained eighteen pounds, during this period of time. We saw him again thirteen months later, and roentgenogram was taken. It showed good functioning of the newly-established passage between the stomach and jejunum. The man has gained forty pounds and feels perfectly well.

The pathological report of Dr. F. B. Mallory, of Boston, is quoted below:

Clinical Diagnoses: Chronic indurated gastric ulcer (beginning malignant changes?); cholelithiasis.

Microscopic Examination: Stomach shows an old ulcer with a thin layer of leucocytes and fibrin on the surface in places. The central portion of the ulcer is lined by fibrous tissue infiltrated with eosinophiles and lymphocytes. At the sides of the ulcer an epithelial tumor, in part solid, in part glandular, is infiltrating the mucosa and the underlying tissue including on one side the muscle coat.

Diagnosis: Cancer.

*This is one of the few cases where the lesion suggests a cancer starting in a chronic ulcer. This view is favored by the lack of tumor beneath the central part of the ulcer.*

Gall Bladder: Mucosa apparently somewhat dried before the tissue was fixed. Microscopic examination shows considerable infiltration of mucosa and underlying tissue by lymphocytes.

Diagnosis: Chronic cholecystitis.

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## APPENDICITIS SIMULATING PURPURA—CASE REPORT

OTTO TIEMANN BROSIUS, M.D., D.T.M.&amp;H., F.A.C.P.

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Almirante, Panama

E. M., a Nicaraguan mestizo farm laborer, aged 27 years, was brought to the Almirante Hospital on a stretcher, April 3, 1929; and was admitted to the Medical Ward on the service of Dr. Ernst Thonnard-Neumann.

**HISTORY OF PRESENT ILLNESS.**—The patient had had fever, as well as attacks of vomiting and abdominal pains, for the preceding few days; and, during that period of time, had been intoxicated almost continuously. Because of the severe abdominal pains and constipation, he took a large dose of castor oil 2 days before he came to the Hospital; and stated upon admission that, since he had taken the purgative, he had been vomiting blood and bile and had passed considerable blood in the stools. The writer was called into consultation by the ward physician; and a brief summary of the findings are given below.

**PHYSICAL EXAMINATION ON ADMISSION.**—The patient was well developed but undernourished. His skin was dry, but his temperature was normal. A careful examination of all the organs of the body proved negative, with the exception of the abdomen which showed the following positive findings:—The spleen was markedly enlarged, and hard. In the lower right quadrant there was a palpable sausage-shaped mass, which was quite firm and deep; and adherent to the deeper structure.

It did not appear very sensitive to the slight pressure we dared exert, and did not pulsate. There was a moderate, but not marked, degree of abdominal rigidity; but no pain resulted from sudden release of pressure.

**LABORATORY FINDINGS ON ADMISSION.**—*Stool* showed a large amount of fresh blood.

*Urine* showed an acid reaction, a trace of albumin, occasional pus cells and hyaline casts; many red blood cells; and was negative for sugar.

*The blood examination showed the following:*

Red blood-count, 4,000,000

The white blood-count was reported as below normal

Blood platelet count, 284,000 or 71 per 1,000 red blood corpuscles

Differential white blood-count:

Polymorphonuclear neutrophils, 35%

Staff forms (transitional forms of polymorphonuclear neutrophils), 10%

Youth forms (metamyelocytes), 12%

Lymphocytes, 40%

Eosinophiles, 2%

Large mononuclears, 1%

Haemoglobin, 70%

Coagulation time, 5 minutes

Bleeding time, 2 minutes

Meinicke test, negative

SUBSEQUENT CLINICAL AND LABORATORY OBSERVATIONS.—On the day after admission, the temperature was 100°F.; the pulse rate, 96; and respiration, 20. The patient had vomited several times during the night, and again complained of severe abdominal pains which could not be definitely localized. Early in the morning, he passed dark liquid stools containing blood. The conjunctivae were jaundiced. The temperature ranged between normal and 100°F., for several days; but on the 6th day after admission it rose to 100.5°F.; and the following symptoms developed: slight swelling of the wrist, ankle and elbow joints, with tenderness (the elbow joints being particularly affected); purpura-like ecchymosis on the feet and lower parts of the legs; and a maculopapular eruption over the entire body. Blood continued to be passed in the urine and stools; and the red blood-count fell to 3,750,000, and the haemoglobin to 60%. The picture in general began to resemble Schönlein's disease, except that the tenderness in the region of the joints was not as severe as might be expected. Because of the abdominal pains which were becoming more intense; the possibility of the condition being Henoch's purpura was considered, but such a diagnosis was rejected as improbable.

On the 8th day of hospitalization the fever rose to 103°F.; and a differential white blood-count at this time showed polymorphonuclear neutrophils, 47%; staff forms (transitional neutrophilic polymorphonuclears), 3%; youth forms (metamyelocytes), 10%; lymphocytes, 39%; and large mononuclears, 1%. The blood platelet count was 247,000, or 65 to 1,000 red corpuscles. The white blood-count was still below normal.

OPERATIVE PROCEDURE AND RESULTS.—As his symptoms grew gradually worse, with a further rise in temperature, an exploratory laparotomy, was recommended. Dr. Wendell S. Dove operated, and reported the following findings: "Retrocecal appendix, gangrenous and bound down by adhesions. Slight amount of pus but marked induration of surrounding tissues." An appendectomy and a caecostomy was then done. The temperature became normal immediately after the operation was performed, and remained so subsequently. The drainage tube in the abdomen was removed on the 8th day; the caecostomy tube was removed on the 14th day; the caecostomy fistula was closed on the 16th day; and the patient was discharged on the 21st day after operation.

CONCLUSION.—It is possible that a haemolytic organism may have been responsible for the appendiceal infection.



## PREGNANCY AND LABOR IN THE ELDERLY PRIMIPARA (WITH CASE REPORT)

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For various social reasons many women of the present era approach their first childbirth at an age much more advanced than those of the preceding generations. Many of these women have a great fear of childbirth; which is encouraged by lay tradition of the difficulties and dangers involved, and often is not disabused by the advice of the attending physician. In this commonly accepted belief there is undoubtedly a basis of truth, but the admirable study of Schulze<sup>1</sup> has demonstrated that the difficulties and dangers of labor in elderly primiparae have been somewhat exaggerated. Practical experience has shown that women who have previously borne children, even though their age is advanced and the interval after the last birth has been great, are not subject to greater pain and danger than younger women.

Tumors, especially fibromyomas, in elderly women are liable to be larger than in younger ones; but the former are more likely to have submitted to treatment before becoming pregnant.

Special emphasis should be laid on the mental reaction of this class of patients, and every effort made to allay their fears. Sedative drugs, used sparingly, are of considerable benefit; but repeated mental suggestion is more reliable and effective.

Though Harris<sup>2</sup> has shown by a series of cases that women who have fibromyomata and have never been pregnant are often sterile as the result of other causes than the presence of tumors, I believe that fibromyomata were the cause of the relative sterility in the case here reported.

## CASE REPORT

*Past History.*—Mrs. C. M., age 49 years, complained of a peculiar indigestion, and a wretched tired feeling every morning on arising. There had been no vomiting, and nausea had been slight. She has had no breast changes nor unusual sensations. Menstruation began at the age of thirteen years, and had always been regular up to the date of her marriage ten years ago. There had been no complaint of chronic pelvic trouble. Four months after marriage, she had an abortion at about two months; four months later a second abortion occurred, at two months; and there was a doubtful history of a third abortion, at three weeks, occurring five years later. Her last menstrual period was completed on January 8, 1922. She complained of pain in the left lower abdominal quadrant.

*First Physical Examination.*—A robust white woman of heavy build. She was nervous and apprehensive, but the general physical examination was otherwise

negative except for deep tenderness in the lower abdomen. Pelvic examination was refused. Diagnosis: Probably pregnancy.

*Second Physical Examination.*—The patient returned at about the end of the fourth month of amenorrhea. The pain in the left lower abdominal quadrant had become more severe. The breasts were enlarged and had become painful; and nausea and vomiting were frequent, both day and night. The patient was extremely nervous and hysterical. Vaginal examination showed normal external genitalia, without the usual softening and other changes of pregnancy. The pelvic cavity was adequate. The cervix was very soft, and slightly open but not obliterated. The uterus was enlarged to the umbilicus, and distinctly nodular. Foetal heart beats were heard on the left side of the abdomen, below the umbilicus. The urine was negative, as it was on the previous examination. The blood-pressure was systolic 134, diastolic 86.

*Hospital Admission.*—On October 27, 1922, the patient entered the hospital. She had made her will, and had bidden her friends farewell with the firm belief that she was going to her death. This belief had been strengthened by the comments of her friends, who considered her condition in the same light.

*Treatment.*—Labor was induced by quinine (15 grs.), hot enema, and manual dilatation of the cervix. Ineffectual pains continued for about four hours, and then ceased entirely. On the following day, under aseptic conditions, the hand was introduced into the cervix; and pains began and continued for five hours, when the cervix was freely dilated and the head engaged. The pains having ceased, the patient was allowed three hours rest; and was then given half an ampoule of pituitrin, which induced regular pains of moderate intensity. Three hours later, after a right lateral episiotomy had been done, a normal female child weighing seven and one-half pounds was delivered in a left vertex position. Twenty minutes later, with slight assistance, a normal placenta was delivered.

*Subsequent History.*—Convalescence was uneventful, and the mother and child left the hospital on the fourteenth day. The final vaginal examination showed the uterus to be well involuted but distinctly nodular. The mother, on the date of her delivery, was 49 years, six months, and three days of age. The temperature reached 99.4°F. during the first two days, but was normal otherwise while she was in the hospital.

There was considerable improvement in the nervous condition of the mother after delivery, but she failed to have further menstrual periods. In less than a year, typical symptoms of the menopause began and continued, in a varying degree, for two years. In a letter received a short time ago, she stated that her health was very good, and that the child, who had reached the age of seven, was robust and of normal mentality. The photograph of the mother and the child which accompanied the letter, certainly confirmed the mother's statement.

*Comments.*—A case of primary labor, in a physically healthy woman nearly fifty years of age, is reported. It is interesting to conjecture that the cause of previous abortions and relative uterine inertia was the presence of several small

intramural or subserous fibroids. The final implantation of the ova probably took place at a site unaffected, or very slightly affected, by the fibroid growth. As the result of the menopause coming on quickly after delivery, there was a marked retrogression of the tumor growth associated with the normal uterine atrophy.

*Conclusions.*—(1) That there is an almost universal fear of pregnancy in women past thirty years of age who have not previously borne children.

(2) That age alone does not warrant this fear.

(3) That the prognosis in elderly primiparae is more dependent upon the general health and anatomical normality than it is in younger women.

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#### PLACENTA PRAEVIA—CASE REPORTS

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#### PRELIMINARY REMARKS

This paper is written with the purpose of recording 4 interesting cases of placenta praevia which have been treated in the Banes Hospital.

The methods used in these cases were metreurysis and Braxton-Hicks's version. Caesarian sections were not practicable, as the patients in every instance had bled profusely while they were being treated by outside physicians before they came to the Hospital; and the principal problem which confronted us was to arrest the haemorrhage and save the lives of the mothers.

Diagnosis was made by thorough vaginal examination, under strictly aseptic conditions. The whole hand was introduced into the vagina, and the index finger inserted its entire length through the cervix. This finger was swept around the whole circumference of the lower uterine segment. An active haemorrhage resulted invariably from these manipulations. This manual examination was usually accomplished without difficulty, as the vagina of multipara is very tolerant. In each case, a preliminary examination was made with speculum and vulsellum.



After the diagnosis was made; and if the cervix permitted it, the membranes were ruptured and a Voorhees's bag inserted into the amniotic sac. The vagina was cleaned by swabbing it with a 2 per cent solution of mercurochrome, which the author considers preferable to any kind of douche. After checking the haemorrhage, hypodermoclysis and other stimulating agents were administered.

After dilatation in an engaged vertex presentation of a dead fetus, and when the bleeding was arrested, no other measures were necessary and the labor proceeded spontaneously. Bleeding, after delivery and expulsion of placenta, was not excessive; and the uterus contracted well in each case. Subsequent to the delivery, a careful examination of the vagina and the cervix was made for tears.

#### CASE NO. 1

*History.*—A septipara, 24 years of age, had suffered from malaria on several occasions. The patient was anaemic and emaciated; and both lungs were dull on percussion and showed cog-wheel respiration and crackling sounds on auscultation. She had been pregnant for seven months, and had bled at more or less frequent intervals for 5 days during the second month. On the day of admission she had had a profuse haemorrhage in the morning.

*Examination and Operative Procedure.*—The mother was still bleeding when she entered the Hospital. The fetal heartbeats were not perceptible. The dorsum of the fetus was to the mother's left, and the head was above the inlet. The internal examination was accomplished easily, as the patient had a very wide vagina due to an old perineal tear; and the entire hand was inserted without difficulty. The cervix was not effaced, but was patulous; and, after dilatation, admitted three fingers. Placental tissues were felt to the right side, and occupied a fifth of the circumference of the internal orifice. The membranes were ruptured immediately; and, with the aid of a vaginal speculum, a #4 Voorhees's bag was inserted into the amniotic sac. The cervix was grasped with the vulsellum, and brought forth; and gentle traction was applied to the Voorhees's bag. Hypodermoclysis was then administered, and after 1 hour the bag was passed into the vagina. A larger bag (#5) was then inserted. After two hours, labor pain started and the bag was passed into the vagina, and the patient experienced bearing-down pains. Examination revealed that the fetal head was deeply engaged in the left occipito-anterior position. The cervix was fully dilated, and bleeding had ceased.

When the head was in the perineum, a low-forceps delivery was done to lessen the strain upon the mother. The placenta was expelled ten minutes later, and there was very little bleeding subsequently. A thorough examination of the vagina and the cervix was made, but no indications of lacerations or tears were found. Puerperium was afebrile, and the patient was discharged eight days later.

*Diagnosis.*—Placenta praevia marginalis.

## CASE No. 2

*History.*—A bipara, who was nine months pregnant, stated that one month previously she had had a haemorrhage which was most profuse on the first day and gradually decreased daily until ten days later when it ceased entirely. There was no more bleeding until the night preceding the day of hospitalization, when a very copious haemorrhage occurred; and she was treated at home by an outside physician, who used the only material available—a shirt—for packing, and sent the patient to the Hospital.

*Examination and Operative Procedure.*—She was admitted at 7:25 a.m., with a temperature of 102°F.; pulse, 112; and respiration, 28. At 9 a.m. the temporary packing was removed; and the vagina was douched with  $\frac{1}{2}$  per cent lysol solution, after which 2 per cent mercurochrome was instilled into the vagina. There was a thick, purulent, foul-smelling vaginal discharge. The entire hand was easily passed into the vagina and the cervix was found dilated sufficiently to admit 2 fingers. A partial placenta praevia was found occupying three-fourths of the circumference of the internal orifice. The examination provoked a severe haemorrhage. A cervico-vaginal packing was applied at once, and the patient placed in bed and given 400 c.c. of normal saline solution by hypodermoclysis.

At 2 p.m. of the same day, after the patient had recovered her strength and the hemorrhage had ceased, she was taken to the operating room and the packing was removed. A haemorrhage started; but the cervix was now well dilated, and admitted four fingers. The membranes were ruptured, and, after a #5 Voorhees's bag was inserted, the bleeding stopped immediately. Labor pains started about 7 p.m., and the bag was passed into the vagina. There was very little bleeding. Examination revealed the head in the right occipito-anterior position. The patient was spontaneously delivered at 9 p.m.; and the placenta expelled at 9:10 p.m. There was only a normal amount of bleeding after the delivery of the placenta. At this time, the pulse rate was 132; the temperature, 102.5°F.; and the respiration, 32.

The following day the patient had a chill, and the temperature rose to 104.5°F. A blood examination showed aestivo-autumnal malaria parasites. Lochia was purulent, and had a very disagreeable odor. A severe febrile puerperium followed, during which the temperature oscillated between 102° and 106°F. for sixteen days. Lochia became more fetid, but scantier, day by day. Intra-uterine douches with Dakin's solution were given daily; after which a gauze drainage, soaked in 2 per cent mercurochrome, was left in the uterus.

On the 9th and 10th days of hospitalization mercurochrome was given intravenously; but these injections had to be discontinued, as they provoked a diarrhoea with 9 to 12 movements per day. She died on the 16th day, with puerperal fever.

*Diagnosis.*—Placenta praevia partialis.

## CASE No. 3

*History.*—A 17-year-old primipara, was 8 months pregnant. The previous history was without significance, although she had been told that she was anemic. Fifteen days prior to admission to the Hospital, she began to bleed. At first it was only a few stains of blood every evening, and none in the morning; but it increased daily until, one hour before she entered the Hospital, the bleeding was so profuse that she was awakened by it and found that she was practically bathed in her own blood. She had not experienced any labor pains or other symptoms. The Officer of the Day packed her, and administered morphine  $\frac{1}{4}$  gr.

*Examination and Surgical Procedure.*—She was examined at 8 a.m., and the external examination revealed a left occipito-anterior presentation, and the fetal heart sounds present. The packing was removed, and the vagina swabbed with 2 per cent mercurochrome. The cervix was soft, with very little dilatation; but one finger was inserted and placental tissues were found around the whole perimeter of the orifice. Bleeding was started by the examination; and an attempt to rupture the ovum provoked a copious flow of blood, followed by collapse of the patient. The cervix and the vagina were packed thoroughly, after which she was given stimulants and 500 c.c. of normal saline solution by hypodermoclysis. There was very little bleeding during the balance of the day, and the pulse rate dropped from 130 to 100. The packing was removed the following morning. There was a moderate dilatation; and a #3 Voorhees's bag was inserted extra-ovularly, and the vagina was douched with  $\frac{1}{2}$  per cent lysol solution. At 2 p.m. another bag was inserted extra-ovularly. Each insertion of the bag caused some haemorrhage.

At 4 p.m. the patient was taken to the operating room, and placed under ether anaesthesia. The cervix being found well dilated, the hand was introduced into the vagina and through the cervix into and through the placental tissue; and the membranes were ruptured rapidly. Version was performed by grasping the right leg of the fetus, which was brought down and the hips engaged. Profuse bleeding was started by these maneuvers, and the patient collapsed; so that hasty delivery, followed by immediate expression of the placenta, was necessary. The mother was then placed in an exaggerated Trendelenburg's position, and hypodermoclysis administered. After expression of the placenta, it was found that the opening made in it by the operator's hand was only one inch behind the insertion of the umbilical cord which coincided with the center of the cervical orifice—so that the baby was delivered through the placenta praevia centralis. A careful examination after the delivery showed a cervico-vaginal laceration, which was not sutured immediately on account of the patient's condition.

During the first three days of puerperium, the lochia had a very foul odor; and the temperature was 103°F. However, the temperature gradually subsided day-by-day, so that on the 8th day it was 99°F. in the morning, and 101°F. in the evening. The vagina was douched daily with  $\frac{1}{2}$  per cent lysol solution, but no intra-uterine treatment was given. Hypodermic injections of 1 c.c. ampule of



Omnadin (Bayer) daily, were administered for four days. By the 15th day, the vaginal discharge was very scanty; the temperature was normal, and the patient had gained in weight and general appearance. However, on the 18th day there was a rise in temperature again; and phlegmasia alba dolens developed in the right leg. It was treated with hot applications of magnesium sulphate. The temperature was once more normal on the 25th day, and continued so thereafter. On the 30th day she was allowed to sit up in a chair for a short time. During this stage of the illness, several boils and small abscesses appeared on the posterior part of the right leg and thigh, and required drainage; and on the 36th day a localized cellulitis of the middle finger of the right hand developed and was incised. She was discharged on the 39th day.

*Diagnosis.*—Placenta praevia centralis, in a primipara. (Note—It is the opinion of the author that this is a very rare case, as he has been unable to find in the available literature any reference to a case of placenta praevia in a primipara.)

#### CASE No. 4

*History.*—A quadripara, 28 years old, was 6 months pregnant when I was called to see her in consultation with an outside physician. The patient stated that profuse bleeding, which lasted for 7 days, had occurred when she was 3 months pregnant; and had given her the impression that she had aborted.

*Examination and Surgical Procedure.*—External examination revealed the fetal heart sounds present, and located below and to the left of the navel. The buttocks of the fetus were in the fundus, with the dorsum towards the mother's left side. The head was not engaged, and the fetus was movable above the symphysis. As the patient had been bleeding for 17 days preceding my visit, the diagnosis of placenta praevia was suggested and it was recommended that she be sent to the Hospital for further examination and treatment.

The patient did not enter the Hospital until 2 days subsequent to the visit mentioned previously and after a more severe haemorrhage had started at home. She was admitted at 9 a.m., at which time fetal heart beats could not be heard. Vaginal examination showed a dilated ulcerated cervix, which admitted two fingers. The amniotic sac was perforated, and a #3 Voorhees's bag inserted intra-ovularly and traction made intermittently. At 11 a.m. a #5 bag was inserted; at 4 p.m. the patient began to have labor pains; and at 5 p.m. the bag was found in the vagina. There was very little bleeding; and the head of the fetus was engaged in the left occipito-anterior position. The head was delivered at 6:30 p.m.; and the placenta was expressed shortly thereafter, with very little bleeding subsequently. The patient recovered, with a normal afebrile puerperium.

*Diagnosis.*—Placenta praevia marginalis.

#### SUMMARY

Four cases of placenta praevia are recorded.

The fetal mortality was very high; as three of them were stillborn, and the one

delivered alive was affected by the haemorrhages which occurred before the patient entered the Hospital and died 4 days after its birth.

The mothers' mortality was relatively low—25%.

In two cases the puerperiums were afebrile or almost afebrile; while in the two other cases there was puerperal fever from septic infection, which caused one death.

There were no deaths from haemorrhage.

The procedure followed may be briefly summarized: Every effort was made to stop the haemorrhage promptly, and to facilitate by hypodermoclysis the replenishment of the blood supply. Special care was exercised to avoid damaging the cervix and to refrain from undue intra-uterine manipulation post partum. The methods used were metreurysis and Braxton-Hicks's version; and removal of the placenta by expression.

## PSEUDOMUCINOUS CYSTADENOMA—A CASE REPORT

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Pseudomucinous Cystadenomata, also known as Paramucinous Cystadenomata or "Cystadenoma Evertens", are reported in the literature as occurring principally (if not entirely) in the ovary. They are usually multilocular and secrete a gelatinous substance. This gelatinous substance is produced by the cells lining the cyst wall—the increase of which causes the rapid growth and the formation of secondary or daughter cysts. The latter may be numerous surrounding the primary cyst and also may attain a large size individually. They are practically always confined to the ovary of one side, being bilateral only rarely. Their origin is not definitely known, but is thought to be congenital.

The following case, with accompanying illustration, of an ovarian new growth removed at operation is reported as approaching very much the description of this type of cystic tumor.

### CASE REPORT

*History.*—Sra. D. S., white Colombian female, age 36, primipara, had married within the past two years; and about nine months ago gave birth in this Hospital to a normal child which is alive and well. About a month ago she was again admitted to the Hospital with a history of severe abdominal pains associated with fever and vomiting. The pains and vomiting had become quite intensified during the last twenty-four hours preceding hospitalization. At the time of admission her temperature was about 100 degrees; urine, negative; blood, negative for malaria; haemoglobin, 75%; stool, *Entamoeba histolytica* ++.

*Physical Examination.*—Palpation revealed a large tumor mass in the lower abdomen. There was no muscular spasm and only slight tenderness. Bi-manual examination revealed a large irregular movable tumor palpable well above the brim of the pelvis. The patient was quite haggard and exhausted from pain and vomiting, and consequent loss of sleep. Immediate operation was advised.



FIG. 1. PEDUNCULATED CYSTIC TUMOR REMOVED FROM RIGHT OVARY  
(Approximately  $\frac{1}{4}$  of actual size)

*Operative Procedure.*—An operation was performed the next morning under spinal anesthesia. This showed a large pedunculated cystic tumor of the right ovary filling the right side of the pelvis and extending well up into the abdominal cavity. Its color was a glistening pearly white; and it was multilocular, with numerous secondary cysts attached to it though seemingly cut off from the main cavity of the parent cyst. There was a plastic exudate around the immediate



vicinity of the tumor and spreading out over the other pelvic viscera. A large quantity of sticky, flake-like brownish fluid, which was free in the abdominal and pelvic cavities, complicated matters somewhat. Some doubt was entertained as to whether this was ascitic fluid, lending a suspicion to malignancy as such ascitic fluid is described in some of the text-books as accompanying sarcomata.

On gross section after removal, the tumor contained many compartments of varying sizes filled with a whitish sticky, jelly-like substance which would not flow. The intervening stroma was somewhat friable, in contrast to a tough thickened capsule which enveloped the entire tumor.

The left ovary showed some cystic degeneration also, but to a comparatively minor degree.

There were no secondary growths adherent to the parietal or visceral peritoneum—sometimes found when the contents of such cysts escape into the abdominal cavity. Under such circumstances there is a tendency to recurrence and the condition is classed as carcinomatous.

However, because of a very remote possibility of malignancy a complete subtotal hysterectomy was considered advisable. The patient made an uneventful recovery in about three weeks.

*Comments.*—Although there were no evidences of a tumor either during pregnancy or the puerperium, it is believed that her recent marriage and pregnancy had stimulated the growth.

Neither the exact size nor weight of the tumor was determined, but grossly I should say that it was easily 4 times the size shown in the illustration (p. 220) and weighed close to 5 pounds. Previous to photographing, the specimen had been placed for 24 hours in 10% formaldehyde solution.

The report on the pathological examination was as follows:

*Microscopic Examination.*—Shows a section of an ovary containing a corpus luteum (early stage) and two follicular cysts. Sections of the tumor show numerous cystic cavities lined with cylindrical cells. The nuclei are at the base of the cells. In places the epithelium is thrown into slight papillary projections. In other places they look more like simple glands.

*Microscopic Diagnosis.*—Adenocystoma showing slight papillary type of growth in places; to be regarded as a benign tumor.

While it is stated in the literature that such tumors are not uncommon, I have reported this one as being the first encountered by me after innumerable operations in this section of the country.

## INTRACRANIAL HEMORRHAGE OF THE NEW-BORN WITH PARTIAL OCCLUSION OF THE FONTANELS

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Complete or partial fetal ossification of the cranial fontanel has, from time to time, engaged the interest of pathologists and obstetricians. For the most part, comment upon this unusual abnormality has been confined to conjecture upon the obscure underlying causes of abnormal bone development.<sup>1,2,3</sup> Other writers have been occupied with a consideration of the condition as a cause of dystocia. Discussion of the subject from the standpoint of infantile morbidity has been somewhat meager.

*Previous Case Reports.*—Thus Leahy-Lynch<sup>4</sup> reported the necessity of instrumental delivery in a case of premature ossification of the sutures and fontanel, after a labor so protracted and shocking that puerperal mania was produced. The infant in this instance was healthy; molding and overlapping of the cranial bones having been entirely absent during descent in the birth canal, and injury to the intracranial structures apparently avoided. Marr<sup>5</sup> adds an example of dystocia due to the same cause, with sequelae of abnormal drowsiness and irritability in the child. A second case, reported by the same writer, was characterized by precipitate delivery from a multipara. This infant presented complete closure of the sutures and fontanel and, at the age of three weeks, died after a series of convulsions. Marr's third case reported concerns the death, at five and a half months, of a child with complete closure of the anterior and posterior fontanel. Cerebral compression was manifest. In this instance, as in the second, increase of intracranial pressure was associated with an attack of diarrhoea.

The case report adduced herewith is of interest for the following reasons: (1) Convulsions of great severity in a new-born infant were associated with bloody spinal fluid and abnormal ossification of the fontanel. (2) Complete arrest of symptoms followed the introduction of measures designed to reduce intracranial pressure and to arrest intracranial hemorrhage.

*Case Protocol—Case No. 628 (Quirigua Hospital, Guatemala).*—Baby S., female, full-term infant was delivered of a primipara on April 13, 1929, at 12:40 p.m. Labor had been somewhat longer than 24 hours, and had been characterized by severe dystocia. The infant's head was deeply cyanosed upon delivery, but revived quickly when a complete loop of tightened funis was divided and released from about its neck. The infant was normally quiet throughout the day, but twice vomited mucus. During the night, it was reported as extremely restless and fretful, despite normal attempts at nursing and the free passage of meconium.

At 9:30 a.m., on April 14, the infant had a sudden seizure characterized by spasmodic respiration, feeble heart action, pallor and cyanosis. This was a

prelude to a series of more than 60 convulsions lasting about 70 hours. The onset of a convulsion was later signalled by twitching of the orbicularis oculi and the levator anguli oris muscles of one side of the face, followed by carpal spasm of the corresponding hand and proceeding to a generalized clonic convulsion affecting the entire body. At the beginning of each seizure, the child's respiration became slower; later assumed Cheyne-Stokes' rhythm and, towards the conclusion of a convulsion, was either suspended or became undiscernable. At this time the waxy pallor first observed gave place to ashen cyanosis. During the last moments and at the end of an attack, the heart action was so enfeebled and prostration so extreme, that attendants were often uncertain whether death had supervened. Between attacks, the infant was of good color and normal appearance, but almost motionless, crying little and nursing indifferently. The hands were in almost constant carpal spasm (tetany) from the time of the third convulsion until near the end of the series. Contraction of the feet was, however, not present except during periods of general spasm.

Physical examination revealed a full-term female infant weighing  $6\frac{1}{2}$  lbs. The only gross abnormality presented was occlusion of the fontanels. The anterior aperture was about  $\frac{1}{2}$  normal size, while the posterior fontanel was entirely closed. Palpation of the cranium permitted little motion at the sutures; and a sensation of tension was supported by visible evidence of slight bulging of the integument overlying the anterior fontanel, and absence of pulsation. The sutures were narrow, but not ossified.

This patient was first seen by me after she had had several convulsions. Three seizures, occurring in rapid succession, were of such gravity that adrenalin and atropin were administered hypodermically as circulatory and respiratory stimulants. The first 4 attacks observed were limited to respiratory spasm, pallor and cyanosis. At 11:00 a.m. twitching of the right side of the face and the right hand signalled the onset of an attack which terminated in generalized clonic spasms. The majority of the succeeding attacks were of this character; in approximately one third, however, spasm of the left side of the face and hand was a premonitory sign. The temperature was normal; the bloods of the mother and the infant were negative for malaria; erythrocyte count of infant, 4,120,000; leukocyte count, 5,200; coagulation time 4' 20"; bleeding time 3'. Babinski's sign was present, and retraction of the head with some rigidity of the neck persisted between convulsions.

At 11:30 a.m., a lumbar spinal puncture was done. The fluid emerged under apparently normal pressure but was of uniformly amber color; and, upon standing, deposited blood in quantity. 10 c.c. were withdrawn. 5 c.c. of maternal venous blood were injected intragluteally, and an ice cap applied to the infant's head. Two drachms of magnesium sulphate crystals, dissolved in two drachms of water, were given by mouth; and a saline enema was administered. The magnesium sulphate was given at 4-hour intervals for 3 doses; and a single dose was given at 9:30 p.m. on the following evening. Two grains of calcium lactate



in sweetened water every 2 hours, and a like amount of potassium bromide every 4 hours, were ordered.

No immediate benefit was seen to follow the institution of these measures. In fact, the convulsions became more frequent (5 to 15 minute intervals) and lasted longer (3 to 7 minutes). At 5:00 p.m., a second lumbar puncture was carried out, and 5 c.c. of a similar yellow fluid were withdrawn. In the interim between punctures several copious watery stools were recorded. From about the time of the second puncture, a gradual improvement was noted. At midnight,



FIG. 1. INFANT AT  $4\frac{1}{2}$  MONTHS. NORMAL INTELLIGENCE AND ABSENCE OF CRANIAL DEFORMITY ARE MANIFEST

cyanosis was absent. During the following day, the epileptiform movements became less severe and less frequent, and the night of April 16 witnessed the last two convulsions. Carpal spasms persisted for another day, and at their termination, the administration of calcium lactate and bromide salts was discontinued.

During the remainder of this infant's hospital stay, (3 weeks), it was in good health, showed no indication of heightened intracranial pressure, and gained weight normally. The mother suffered a mild inflammation of the left saphenous vein which prolonged her stay in the hospital but presented no other evidence of the effects of dystocia.

Five months after birth, the infant was reported well, of average weight and normal intelligence, and without cranial deformity.

## SUMMARY

Relief of intracranial pressure was apparently a life-saving measure in a case of intracranial hemorrhage of the new-born with partial occlusion of the fontanels.

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## ACUTE ARTHRITIS IN THE NEW-BORN (WITH CASE REPORT)

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In search of the available literature, I was surprised at the paucity of information in regard to arthritis occurring in the new born child.

Holt<sup>1</sup> infers that arthritis of the new born may occur from causes other than gonococcus infection, and observes that the portal of entry often could not be definitely determined. He mentions two cases of acute gonococcus arthritis occurring some time during the first month of life, and classifies these two cases as infections of the newly born.

General symptoms occur and may precede the local ones. Both general and local symptoms may be very severe, to the extent of causing great permanent disability, or even death.

In a series of 73 collected cases of arthritis in infants, the hip was most frequently involved, and the small joints rarely. In a series of 26 cases of gonococcal infection, the small joints were most frequently involved.

Pocock<sup>2</sup> and Schoffer<sup>3</sup> report two cases of the transmission of acute articular rheumatism from the mother to the fetus presenting, in one case at once, and, in the other, at the end of three days, all the symptoms of the disease.

## CASE REPORT

Case #1266.—Normal male child, weight 9 pounds, born at 10.35 a.m., May 11, 1929. The birth was primiparous, precipitate, and there was a short cord

about the child's neck. There was some cyanosis; breathing was not prompt, and there was a suspicion that the child had inhaled some fluid.

The nurse reported the child as being very fretful during the night of the 13th and, on the following morning, examination showed that the second joint of the left index phalanx was swollen, red and partly fixed in moderate flexion. The abdomen was distended and tympanitic, with the veins showing prominently. Symptomatic treatment was given. The cord stump was normal, and no signs of infection in other parts of the body were found.

On May 15th, the second joint on the right middle finger was slightly swollen. The joint first affected was more swollen and red, but without signs of fluctuation. Apparently, there was much pain on attempted extension.

On May 16th, the second joint on the right fifth finger was moderately affected. The other affected joints were more swollen and reddened.

On May 17th, the first right metatarsophalangeal joint became involved. The previously involved joints were about the same.

On May 18th, the blood cells were 14,200; lymphocytes 61%; large mononuclears 8%; neutrophils 30%; and eosinophiles 1%.

On May 19th, the swelling and redness of the affected joints was most marked. Improvement was gradual until May 25th, at which time all swelling and redness had disappeared, except a moderate degree in the right metatarsophalangeal and the second joint of the left index phalanx. On this date, mother and child left the hospital. On May 22nd a small staphylococcus abscess on the head had been incised and drained.

On May 29th, the child was readmitted with the mother. No acute inflammation was present in any of the joints, altho there was still considerable swelling and limitation of motion in the left index finger and right great toe. During the first three days, the temperature reached 100 degrees Fahrenheit, but remained normal during the balance of a nine-weeks stay in the hospital. The weight on July 24th was 13 pounds, 6 ounces, and the child was in perfect health, with the exception of some residual swelling of the above mentioned joints. There was no redness, pain, nor tenderness, and no apparent limitation of motion. At no time have there been signs of endocardial involvement.

As the mother and baby are living on a remote island, the father was interviewed on December 14, 1929 and stated that the child was in excellent health, with no swelling, redness nor limitation of movement in any joint. Since leaving the hospital, the child has seemed to be active and normal in every respect.

*Clinical History of Mother.*—Normal R.O.A. delivery at 10.00 a.m., May 11, 1929, after about ten hours of hard labor. Second degree lacerations were repaired immediately. On the third day, she began to run an irregular fever reaching as high as 102.5 degrees Fahrenheit, which continued for six days. There was some infection of the repaired tissues. Streptococci, staphylococci and other bacteria were present in the vagina. At the patient's request, she returned to her home on the 14th day after delivery, the uterus not being entirely invo-



luted. On May 11th the blood was negative for malaria; on the 18th day the hemoglobin was 60%; and flocculation (Meinicke) test was negative.

On May 29th, she was readmitted, complaining of fever, with pain and swelling of the left leg, which had begun the night before admission. She was still successfully nursing the baby. A well developed phlebitis involving the left leg was found, and, on June 6th, a similar condition developed on the right leg. She was discharged, cured, on July 29th.

Unfortunately, no blood cultures were done on the mother nor baby so that no conclusions as to the type of infection nor manner of transmission can be drawn. As there was an entire lack of signs pointing to the involvement of the nose, throat, urethra, umbilicus, etc., it is evident that the infection must have developed in utero.

*Summary.*—(1) A case of acute articular rheumatism in a new born child is reported.

(2) A sketch of the mother's history is appended.

*Conclusions.*—That acute articular rheumatism may develop in a new born child, and may present the classical symptoms as found in children six months of age or older.

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## CONGENITAL INTESTINAL APLASIA WITH FATAL OBSTRUCTION IN PREMATURE INFANT

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Two types of intestinal malformations most frequently encountered in the new-born are failure of development of the hind-gut, or proctodeum, and atresia (often multiple) of the jejunum and ileum. Of these, the former represents by far the greater proportion of cases of abnormal intestinal development. In the case to be reported herewith, rotation of the gut was arrested when half completed in an 8-month fetus; and development of the entire large intestine, excluding the anal canal, was rudimentary.

Thus, according to the classification of Sir Charles Ball, two types of abnormalities are represented by the case in point—namely, arrested development of the

hind-gut resulting in virtual absence of the large bowel; and irregular development of the proctodeum, producing a well formed anus which terminated in a cul-de-sac. To these must be added, failure of complete rotation of the fore-gut.

*Case Protocol, Case No. 1512, Quirigua Hospital.*—White male infant born Aug. 3, 1929; fourth child; 2 prior abortions; miscarriage threatened in 7th and 8th months, with associated estivo-autumnal malaria in mother, who was hospitalized on both occasions and received thorough anti-malarial treatment. At the time of the second threatened miscarriage the lower uterine segment was found entirely effaced and the external os dilated 2.5 cm.; and during the last month of intra-uterine life, this condition continued to prevail.

The infant was delivered without incident, after a short labor. It appeared to be an 8-months child; weighed 5 lbs., 5 oz; was well formed; and presented no external malformations. Five hours after birth, the infant had voided, and vomited greenish material resembling meconium. No meconium had been passed by rectum. Milk of magnesia (two teaspoonsfuls) and castor oil (one teaspoonful) were given and quickly vomited. A soap enema yielded only a cast of jelly-like white mucus corresponding to the diameter of the anal canal. High enemata of Dobell's solution at 105°F. were administered, in the hope of dissolving and bringing away more of this thick mucus. Only a few additional grams were secured. A soft rubber catheter could be passed into the anal canal about 4 cm. Digital palpation suggested that the canal terminated at this level.

The following day these measures were repeated without effect. About 3 c.c. of meconium were expelled from the anal orifice during the 24-hour period, but at the end of that time no more meconium was seen. Ascending doses of atropin were administered. During the afternoon and night of the second day vomiting did not occur, and there was little abdominal distension. An attempt was made to X-ray the colon by barium enema; but this was defeated by the infant's activity. None of the contrast fluid could be retained in the anal canal.

On the third day, when it was seen that no meconium had been passed and that distension had increased, hypodermic injections of pituitrin were given as a last medicinal resort. Failing to obtain the desired effect; operation was advised, and the parents acquiesced. Because of the extent of development of the anal canal and the passage of small amounts of meconium, it was considered probable that the point of obstruction existed above the rectum; and laparotomy, instead of perineal section, was decided upon.

Operation was performed on Aug. 5, 1929, at 11:30 a.m.

*Operative Notes.*—Under chloroform-ether anesthesia, a left paramedian incision was made. Yellow, clear fluid escaped from the peritoneal cavity in considerable quantity. The small intestine was distended to about twice its normal diameter throughout its entire length; and terminated in a blind end, corresponding in position to an extremely ill-attached caecum, about 4 cm. in diameter. The entire large intestine was rudimentary in development, about  $\frac{1}{2}$  cm. in diameter, cord-like in appearance, and with an almost impalpable lumen. The

first part of the large intestine was seen to pass through a defect in the mesentery of the small intestine—without obstruction or strangulation, however. The appendix had not become differentiated.

The blind intestinal end was easily conducted outside of the abdomen, and a glass "*Paul-Mixer*" tube introduced therein. Considerable difficulty was experienced in replacing the distended intestinal coils. The abdomen was closed with through-and-through sutures of chromic catgut, anchoring the protruding loop to peritoneum, fascia and skin. Severe shock was evident at the conclusion of the operation.

The infant recovered from the anesthetic. Meconium drained freely from the glass tube. Hypodermoclysis and stimulants were employed. Death, from shock and the effects of obstruction, occurred about 5 hours after operation. Autopsy was not performed.

### LOA LOA—CASE REPORT

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PAST HISTORY.—V. C. D., a white, male citizen of the United States of America, aged 37, had traveled on the west coast of Africa, from Sierra Leone to Angola, during the 23 months extending from November, 1924, to October, 1926. While he was in Sierra Leone in February, 1925, he had an attack of fever which lasted for 3 weeks. It was diagnosed as malaria, and treated with quinine. He was suffering from general debility at the time; and in September of the same year, when he arrived on the Gold Coast, he had another attack of fever which persisted for a period of 1 month. This was also diagnosed as malaria, and he was given quinine, and Iron, Quinine and Strychnin. From October, 1926, to January, 1927, he was in Boston, Mass.; but he then proceeded to the west coast of Panama and remained there until October of the same year, when he returned to Boston. In January, 1928, he went to the west coast of Costa Rica; and while he was there, in August, 1928, he experienced another attack of fever. The same diagnosis was made, and in consequence he went to San Jose, Costa Rica, to recuperate. He resided in San Jose until September; then went to Boston; thence, in October, to the west coast of Guatemala, where he lived until February, 1929; and, during that month, he moved to the west coast of Costa Rica. He stayed there until July, 1929; and then came to the west coast of Panama. He stated that during 1929 he had been enjoying better health than during the preceding few years, and had been able to do more work.

HISTORY OF PRESENT ILLNESS.—The patient sought treatment at the Hospital



on September 5, 1929. He mentioned that during October, 1928, he had had a swelling on the forehead over the right eye. This swelling disappeared, but other swellings developed on various parts of his face during the following 5 days. The skin over these swellings felt tense and itchy, but they were not painful. Only one swelling was in evidence at any particular time. On the day of admission, September 5, at 3:00 a.m., he was awakened by something biting him in the external corner of the left eye; and several times during the morning he was conscious of a pricking sensation in the left eye, which also felt as though it was swollen and puffed out. At 1:00 p.m. there was a slight twitching in the eye; and, when he examined it in a mirror, he saw something that looked like a worm moving below the conjunctiva near the inner canthus. While he was on his way to the Hospital he felt the worm crawling to the external corner of the eye; and it seemed to him as though it was trying to get into the cornea.

**PHYSICAL EXAMINATION.**—The patient was a well-developed and well-nourished white male. The spleen was slightly enlarged, and tender; but there were no other abnormal findings.

**EXAMINATION OF EYES.**—An examination of the left eye revealed a thread-like worm, about  $1\frac{1}{2}$  inches in length, which was moving rapidly in the external corner of the eye below the conjunctiva. The right eye was negative.

**SURGICAL PROCEDURE.**—A few drops of 4% cocain solution were instilled into the eye; and then a small incision was made through the conjunctiva, and a filarial worm was removed.

**LABORATORY FINDINGS.**—Kahn test, negative; stool, negative; urine showed the presence of a small amount of albumin and an occasional hyalin cast. The blood count was 8,000; lymphocytes, 17; transitionals, 2; polynuclear neutrophils, 59; eosinophiles, 22.

*Sept. 5.*—Blood examination revealed the presence of *Loa loa* embryos about 4:00 p.m.

*Sept. 6.*—Blood was positive at 10:00 a.m., for *Loa loa* embryos.

*Sept. 9.*—Blood was positive at 10:00 a.m., for *Loa loa* embryos. The parasites of tertian malaria were also observed, and the regular anti-malaria treatment was administered.

*Sept. 13.*—At 10:00 a.m., and again at 10:00 p.m., the blood was positive for filaria embryos.

*Sept. 14.*—At 5:00 a.m., the blood was negative, but at 10:00 a.m., it was positive.

*Sept. 19.*—At 9:00 a.m. the blood was positive.

*Sept. 22.*—At 9:00 a.m. the blood was positive.

*Sept. 28.*—At 9:00 a.m. the blood was positive.

*Oct. 5.*—At 9:00 a.m. the blood was positive.

*Oct. 13.*—At 9:00 a.m. the blood was positive, but very few embryos were found.

*Oct. 20.*—Only an occasional embryo was found.

## TREATMENT.—

*Sept. 6.*— 1 c.c. of Tartar Emetic, 1%, was administered intravenously.

*Sept. 9.*— 2 c.c. of Tartar Emetic, 1%, was administered intravenously.

*Sept. 12.*—3 c.c. of Tartar Emetic, 1%, was administered intravenously.

*Sept. 16.*—5 c.c. of Tartar Emetic, 1%, was administered intravenously.

*Sept. 19.*—6 c.c. of Tartar Emetic, 1%, was administered intravenously.

*Sept. 22.*—8 c.c. of Tartar Emetic, 1%, was administered intravenously.

This medication failed to produce any perceptible improvement in the condition, as the number of larvae found during the blood examinations were consistently the same. It was therefore decided to use neosalvarsan.

*Sept. 25.*—0.3 gm. of neosalvarsan was administered intravenously.

*Sept. 30.*—0.45 gm. of neosalvarsan was administered intravenously.

*Oct. 8.*—0.6 gm. of neosalvarsan was administered intravenously.

*Oct. 14.*—0.6 gm. of neosalvarsan was administered intravenously.

From October 20 to November 17 no opportunity was afforded to observe the condition of the patient. However, he was admitted again to the Hospital on November 18; and the blood examination made on that date revealed a large number of filarial embryos, demonstrating that the medication used had not effected a cure.

PRIOR INJURY OR DEFORMITY OF THE SPINE REVEALED BY  
X-RAY EXAMINATION IN CASES OF RECENT TRAUMATISM

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Roentgen examination of the spine in cases of suspected injury should be, and usually is, a routine procedure in industrial surgery. The practical application of X-ray visualization of the spine has even been extended by some corporations to include all prospective employees prior to their employment. From the point of view of the corporate employer, compensation suits based upon real or fancied injury to the spine constitute, perhaps, the largest and certainly one of the most unsatisfactory phases of medico-legal activity. Arthritis, spina bifida, scoliosis, fracture of a transverse process, cervical or lumbar ribs, too many or too few lumbar vertebrae, and sacralization of the fifth lumbar vertebra, are examples of pathology revealed by the roentgenograms.

The two cases presented herewith reveal congenital defects of a character designed to augment the ill-effects of actual injury to the spine.

## CASE No. 1

*Spina Bifida with Spinal Concussion.*—D. L., age 23, white, first-class employee of the Engineering Department, Guatemala Division, entered Quirigua Hospital on July 4, 1929. Two hours previously, he had been pinned beneath an overturned motor car. It was, in fact, his belief that most or all of the weight of the car had fallen upon the lower part of his back. Past medical history was irrelevant.

He complained of severe pain in the lower lumbar region of his spine. No marks or discoloration could be determined by examination, nor was rigidity of the spine or crepitus present. There was moderate spasm of the erector spinae and psoas muscles, with the thighs held voluntarily flexed in the position of greatest comfort. Tactile sensation of the legs was diminished; pressure, temperature, and pain sensations were normal. Patellar and Achilles' reflexes were of average intensity; and Babinski's sign could not be elicited. The patient complained of "heaviness" of the legs. Voluntary movements of the legs were free and unrestricted but were said to exact more than ordinary volition. Micturition could not be accomplished for 16 hours after admission. During this time, catheterization was twice resorted to.

Roentgen examination of the spine disclosed spina bifida (occulta) of the fifth lumbar vertebra. (Fig. No. 1.)

Inasmuch as symptoms of compression of the cord of this patient diminished rapidly from the time of first observation, conservative methods were pursued in his treatment. It is not unlikely that the same bony defect which exposed the cauda equina to injury and concussion in this case, served conversely as an aid to spontaneous decompression. Spinal puncture was not performed.

An uninterrupted recovery terminated in discharge of the patient, free of symptoms and after-effects of injury, on July 16, 1929.

## CASE No. 2

*Old Sacralization of Fifth Lumbar Vertebra and Fusion with Fourth Lumbar Vertebra.*—E. B., age 24, white, first-class employee of the Accounting Department of the Guatemala Division, was admitted to Quirigua Hospital on July 16, 1929, complaining of pain in the lower part of his back and in the region of his right kidney. These symptoms had been in evidence for about seven months. During this period, "gravel" had been found in his urine while he was in the hospital of another division.

He volunteered no history of spinal injury. There were no genito-urinary symptoms and the prior medical history was essentially negative. Inspection revealed a sallow young man with coated tongue and shadowed eyes. His appearance was that of an individual who had suffered considerable discomfort over a period of months. The general physical examination was negative except for marked sensitivity to palpation, pressure and percussion over the lumbo-





FIG. 1

sacral and sacral regions of the spine. Movements of the spine were, however, complete in extent and nearly painless; nor was pain produced by downward



FIG. 2

jarring of the head upon the spinal column. The feet were flat, but not painful. Urine examination was negative (2 specimens).

Cystoscopy was done the day following admission. Save for congestion of its neck, the bladder's interior was normal. The right ureter was catheterized with some difficulty, for a distance of about 10 cm.; and a specimen of urine was collected. This was negative. Contrast fluid was injected into the right kidney pelvis, and an x-ray taken.

The pyelogram was imperfect, due to reflux of contrast fluid; but showed the kidney pelvis to be of normal size and in the usual position. The fifth lumbar vertebra was definitely sacralized, and also apparently fused to its fellow above. The appearance of the 4th and 5th vertebrae suggested an old crushing fracture or necrosis. (Fig. No. 2.) It is possible, however, that the incomplete differentiation of the 4th from the 5th vertebra was a part of the congenital fusion of the 5th vertebra with the sacrum. Repeated attempts to secure a satisfactory lateral skiagram were failures.

Upon questioning, the patient recalled "twisting" his back while diving 2 years before. He had pain for about a week subsequently, but it was not sufficiently severe to confine him to bed. He could not definitely recall any injury just preceding the onset of back pain 7 months previously, but stated that he had injured his back several times during the past five years while playing basketball and football. He had no recollection of a major injury, nor any history of illness which would suggest the possibility of tuberculosis or osteomyelitis of the lumbar vertebrae.

The patient was discharged on July 18th but remained under observation for 2 months. No relief from the pain was experienced. Repeated urine examinations (4) were normal. Arrangements were initiated to secure a suitable back support, when the patient was transferred to another division and lost to observation.

This case is obviously one of bony deformity of the spine, predisposing it to the effects of trauma. The etiology of the abnormality is problematical. Simple sacralization of the 5th lumbar vertebra is usually congenital in origin, however; so that the evidence presented in this case would seem to indicate that the lesion was not due to injury but had existed at birth.

## REPORT OF A CASE OF NEGLECTED FRACTURE

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*Preliminary Remarks.*—The case herewith recorded may be classed as a rare example of a careless individual suffering from a severe form of asthenia which was probably produced by uncinariasis and chronic malaria infection. The



accompanying photographs (Figs. 1, 2 and 3) show the very marked difference in his general appearance on admission to the Hospital, and after a period of treatment, respectively.

#### CASE REPORT

*History.*—R. A., a native of Honduras, 27 years old, was admitted to the Hospital on August 16, 1929. The patient stated that he had had fever and



FIG. 1

#### BEFORE TREATMENT

Patient has malaria and uncinariasis. Weight 127 lbs. Red cells 2.8 millions. Hemoglobin 40 per cent.

chills, with headache and backache, daily for 4 days prior to admission. He complained of being unable to perform satisfactorily the work required of a laborer, because his right hand was almost useless. He had fallen from a tree 3 years before, while working with an axe; and had incurred a severe cut and a fracture of both bones of the lower third of the right forearm. Nature had been permitted to take its course, and he had not sought medical attention; and, at the time of his present hospitalization, he came to the Hospital to obtain treatment for symptoms of malaria and not because of the arm injury. His arm had been



FIG. 2

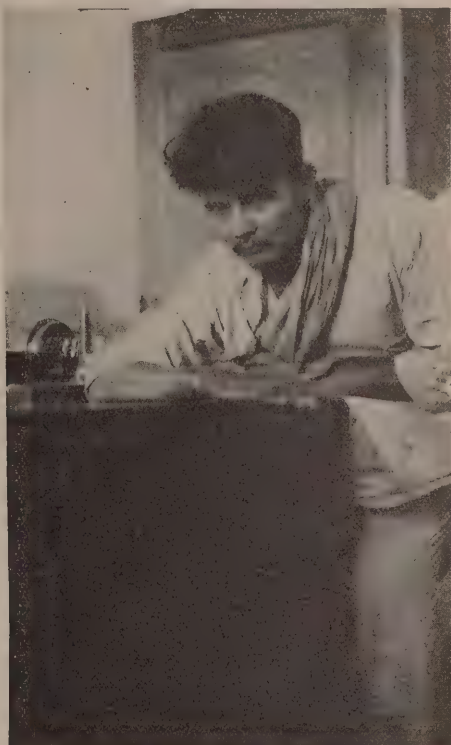


FIG. 3

AFTER HOSPITALIZATION AND TREATMENT

Blood and stool negative. Weight 159 lbs. Red cells 4.8 millions. Hemoglobin 85 per cent.



PLATE 1

BEFORE TREATMENT

Almost complete right angle angulation of forearm and hand can be seen



## PLATES 2 AND 3

## AFTER FIRST OPERATION

Graft on radius end can be seen; and no consolidation of ulnaris end





PLATES 4 AND 5

AFTER SECOND OPERATION

Fresh bone inlay from the tibia can be seen at ulnaris end and nice callus formation on radius



PLATES 6 AND 7

TWO MONTHS AFTER LAST OPERATION

Reabsorption of bone inlay of ulna and almost complete callus formation of both bones is noticeable

allowed to remain in and to heal in a position of severe deformity, which had rendered the right hand practically useless.

*Abnormal Physical Findings.*—The right forearm was at a right angle with the hand, and completely immobile—lack of abduction, pronation, extension, and flexion of the hand and fingers. There was a transverse scar over the dorsal region of the wrist. The x-ray showed that the fragments of the radius and ulnar had healed in a right angle position, with a large callus formation. (Plate No. 1.)

*First Operation.*—With the patient under general ether anesthesia, a longitudinal dorsal incision was made over the lower third of the forearm; the soft tissues retracted; both bones exposed at the point of fracture; and periosteum of each incised and elevated. The bones were then divided with a Gigli chain-saw and chisel. Surplus callus was removed; the hand, straightened; and the ends of both bones approximated. The radius was splinted with a bone-graft furnished from the callus, and fixed with kangaroo tendon; the periosteum and soft tissues were replaced; the skin was sutured with chromic gut suture; and plaster cast applied. (Plates Nos. 2 and 3.)

*Second Operation.*—Three months later the ulna fragments had not united, as shown by motion at the site of the fracture. A second operation was performed as follows: with the patient under general anaesthesia, an incision was made on the side of the forearm, along the ulna; the soft tissues were retracted; the fractured ends of the bone were liberated from interfering muscular tissues, and a groove was made in both ends. A bone inlay was taken from the anterior surface of the right tibia with a double electric saw, and adapted to both ends of the ulna; and was held in position by tying both ends of the inlay to the ulna with kangaroo tendon. The wound was closed with chromic catgut sutures. A plaster cast was applied to the arm, with the forearm in semiflexion and semipronation. (Plates Nos. 4 and 5.)

*Subsequent Treatment.*—After 25 days the cast was removed; and massage, with passive movements of the forearm, hand and finger, instituted.

*Result.*—The patient recovered almost all movements, and is able to use his right hand again. (Plates Nos. 6 and 7.)

## STAB WOUND OF THE ABDOMEN—A CASE REPORT

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C. S., aged 43, Panamanian, male mestizo, farm laborer, well developed and well nourished, was admitted to the Hospital at midnight with a stab wound of the upper abdomen. The accident had occurred about an hour before admis-



sion. The patient was in agony, gasping, and crying out with pain and begging for water in almost the same breath.

His skin was cold and clammy, and the pulse rate was 130 and very weak. A hasty examination elicited:

(1) A ragged dagger wound of the epigastrium in the median line. The wound appeared as though the blade which inflicted it had been turned about maliciously, and stomach contents oozed from it with each respiratory movement.

(2) There was dullness in both flanks and also shifting dullness.

The constantly increasing thirst, and the gradually rising pulse-rate, indicated the necessity of an immediate operation. Ether was used, as the writer considered that the wound was too high for spinal anaesthesia, although the application of the latter would have enabled us to operate sooner.

The abdomen was opened at once through a median line incision. A profuse haemorrhage, which had partly filled the abdominal cavity with blood, was found issuing from a wound in the left lobe of the liver where the dagger had gone through it. The wound was quickly packed, and the bleeding stopped.

It was found, also, that the anterior wall of the stomach had been penetrated; and the gastric contents were emptying into the abdominal cavity. This wound was closed with two layers of sutures. The abdominal cavity was carefully irrigated with warm normal saline solution; drains were inserted in both flanks; and the abdominal wound was closed.

The patient was put to bed, the head of which was kept raised for approximately 10 days. At this time an acute bronchitis developed; and this condition was soon followed by a severe attack of broncho-pneumonia. Notwithstanding this unfortunate setback, the patient's resistance was such that he gradually recovered. On the 29th day after the operation, he was allowed to sit up for the first time; and his improvement continued to complete uneventful recovery.

## AN UNUSUAL MACHETE WOUND—CASE REPORT

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The anatomical location, the treatment, and the end results of machete wounds have been very thoroughly discussed in papers published previously by Gage,<sup>1</sup> Hutchinson,<sup>2</sup> and Aguilar.<sup>3</sup> During the past 19 years, the author has seen a large number of this class of injuries, located in nearly every part of the human body, nevertheless, the case reported below is considered unusual and of special interest on account of the location and extent of the wounds.

## CASE REPORT

*History.*—L. R., male native, aged 24, case #A1194, was admitted May 4, 1929. He had been in a machete fight 2 days previously, and was slashed across the face. He stated that his nose had fallen to his chin and had to be supported with a handkerchief secured over the top of the head.

*Examination.*—The patient's general condition was good. There was an incised wound beginning just below the left orbit in line with the outer canthus and extending to the right and downward to a point  $\frac{1}{2}$  inch anterior to the angle of the jaw. All structures, including the antrum on each side, the nose, the right



FIG. 1

superior maxilla and process, and the palate, had been cut through to the mouth. There was also a transverse incised wound of the tongue, involving the right  $\frac{1}{4}$  of the tissue. The wound extended into the right inferior maxillary process, but there was no apparent fracture of the mandible. A superficial wound, about  $2\frac{1}{2}$  inches in length, was observed on the right shoulder, apparently incurred at the termination of the stroke which had inflicted the other wounds.

*Operation.*—Under intratracheal ether anesthesia, the wound, beginning with the mouth, was closed in layers with chromic catgut. Particular care was exercised in closing the cavity linings and in securing anatomically exact relations of the parts.

*Results.*—During the first 24 hours, the temperature ran as high as 104.5 degrees F. and, for the following 3 days, fluctuated between 100 degrees F. and

101.5 degrees F. Following this period it ran between normal and 99.5 degrees F. for one week. There was some superficial wound infection which, fortunately, involved only a few small areas of the sutured skin.

On May 31, 1929, the patient was given a careful examination. The scar of the wound in the mouth was barely perceptible, and both nostrils were open. No line of scarring could be seen in the nostrils, but there was a tendency to scab formation similar to that found in ozena. There were some slight depressions in the line of skin suture corresponding to the cured superficial infections. Percussion over the maxillary sinuses was not painful. There was complete anesthesia of the nose distal to the wound, of the upper lip, and of the areas at the angle of the mouth. The upper teeth and jaw were firm, but there was tenderness on biting.

The patient was discharged as cured on the date of examination—May 31, 1929. He returned for removal of crusts from the right side of the nose on June 11, 1929. On August 27, 1929, he was admitted for lobar pneumonia from which he ultimately recovered. The photograph shown here (Fig. 1) was taken on September 23, 1929, at which time there was a marked lessening of the anesthetic areas and function was excellent.

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#### READILY CONSTRUCTED APPLIANCES FOR THE RELIEF OF FOOT DROP AND FLAT FEET

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The development of foot-drop in bed patients can usually be combated with success by mechanical means and the application of physio-therapeutic measures, such as massage and active movements.

Probably the most effective instrument for maintaining normal dorsal flexion of the foot in recumbency is a light, molded plaster of Paris splint, applied either to the anterior surface of the leg and the dorsum of the foot, or to the internal-lateral aspect of the leg and to the circumference of the foot at the mid-metatarsal level. The bed clothing should, of course, be suspended over the feet.



*Spring Splint for Foot Drop.*—The simple dorsal spring splint illustrated in figures 1 and 2 was devised by the writer to meet the requirements for an anti-foot-drop appliance which would be available at any time for use on limbs of varying size, would not be affected by wet dressings nor interfere with their application, and would serve to keep the bed clothes off the toes without the use of cradle or hoop.

*Simple Construction of Splint.*—The pair of spring splints shown in the illustration was made in the machine shop at Quirigua, Guatemala. Saw steel  $\frac{1}{8}$  inch

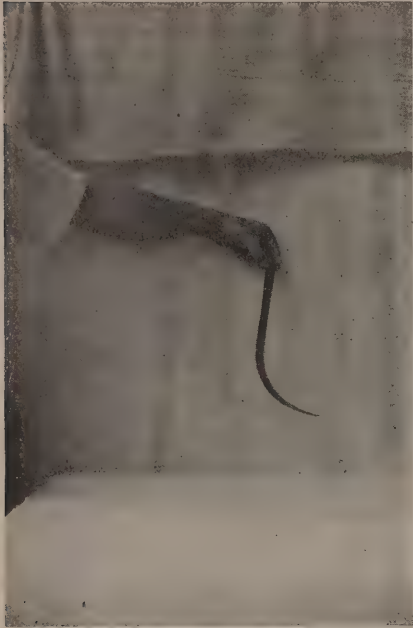


FIG. 1



FIG. 2

FIG. 1. SPRING SPLINT OF SAW STEEL FOR PREVENTION AND CORRECTION OF FOOT DROP IN BED PATIENTS

FIG. 2. SPRING SPLINT APPLIED IN CASE OF SUPPURATIVE ARTHRITIS OF ANKLE JOINT

thick and 1 inch wide was cut in 20-inch lengths, heated to cherry red, bent to a right angle in a long curve at the lower third, and tempered. To be effective, such a splint must have a good "spring," so that when applied to the anterior surface of the leg, it will maintain a constant tendency to dorsal flexion. The splint is padded by wrapping with gauze bandage; and points of pressure upon the front of the leg and the dorsum of the foot are protected by small pads. The distal end of the splint, projecting beyond the toes, forms a protective "tent" of the bed clothes.

In Fig. 2, the splint is shown applied in a case of suppurative arthritis of the ankle joint. Dressing could be easily effected without removal of the splint, which served to immobilize the ankle joint and also to prevent foot-drop.

*"Home Made" Arch Supports and Orthopedic Shoes.*—Because flat foot is a comparatively rare condition among the native Latin-American people, it is not surprising that arch supports and orthopedic shoes are not readily obtainable in many Latin-American communities. In behalf of patients, the writer has vainly endeavored to purchase equipment of this nature in two prominent Latin-American capitals. It may be added that flat foot is not entirely unknown in the natives of these regions, but its occurrence and effects are often disregarded. The native Guatemaltecan for whom the "home made" arch supports and orthopedic shoes illustrated herewith were constructed, had been, for more than a year,



FIG. 3



FIG. 4

FIG. 3. HAND FITTED ARCH SUPPORT MADE OF SADDLER'S FELT  
FIG. 4. SHOE WITH INNER EDGE OF SOLE RAISED  $\frac{1}{4}$  IN.

under treatment for pain in the legs and back without recognition of its cause. After wearing the supports and shoes for two weeks, nearly complete relief of symptoms was experienced. In this case, exercises were also prescribed to strengthen the arches; and later especially designed supports and shoes were ordered from an American firm.

*Felt Arch Supports.*—The hand-fitted arch supports shown in Fig. 3 were cut from  $\frac{1}{2}$  inch thick saddler's felt (procured in the Company's Commissary) with a pair of bandage scissors, and modeled from a cut-out tracing of the outline of the patients' feet. The inner border of each support is of full thickness felt, which is trimmed away symmetrically from a point representing the center of the longi-

tudinal arch to a thin edge at the outer side of the foot and heel. To further support the arch, a second smaller, kidney-shaped pad is cut to conform to the contour of the mid-portion of the foot, with its outer edges similarly bevelled. This pad is sewed with heavy linen thread to the under surface of the larger pad, so that the apex of the arch of the foot is supported by 1 inch of saddler's felt. (The elevation required may, of course, be built up or reduced by varying the number and thickness of the pads.) Finally, the completed support is trimmed to fit the interior of the shoe. It can usually be worn without fixation to the sole. Similar smaller felt pads have been constructed, and worn with satisfaction in cases of flattened metatarsal arch and Morton's toe.

*Alteration of Shoes.*—To overcome pronation, associated with flat foot, the inner border of the shoes' soles and heels should be elevated  $\frac{1}{4}$  inch by "building up" with sole leather. This alteration can easily be made by a rural shoemaker. A shoe so reinforced is shown in Fig. 4. Worn with the felt arch support, such shoes will usually afford a large measure of relief from the pain and disability of flat feet—at least until more suitable equipment can be secured.

## CEMENT-STARCH MIXTURES AS A SUBSTITUTE FOR PLASTER OF PARIS IN THE TROPICS\*

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*Deterioration of Plaster in the Tropics.*—Surgeons working in tropical countries where the humidity is high often witness the rapid deterioration of unused plaster of Paris, resulting from absorption of moisture. This is particularly noticeable when the contents of 5 or 10-pound containers are only partly consumed, as often happens when the use of plaster is not a daily or even a weekly occurrence.

Under these circumstances, it is often found that the plaster has lost its smooth amorphous character, and it becomes coarsely lumpy or mixed with hard, irregular granules. This deterioration is sometimes not apparent until the bandages are applied, when it is observed that the solid portions of the plaster remain dry and unaffected by immersion; the layers of bandage fail to cohere, and the resulting cast readily bends or cracks. Some grades of plaster appear to undergo this important change without exposure, and as a result of aging alone, as the alteration may be seen in plaster taken from freshly opened containers which have been hermetically sealed. There is evidence, therefore, that such "aging" of hermetically sealed plaster takes place more rapidly in tropical localities, than in climates where there is less moisture in the atmosphere.

\* This article was originally published in the June, 1930, issue of *The American Journal of Surgery*.



*Special Methods Adopted in Using Plaster of Paris.*—To overcome these difficulties the following rules are commonly observed in the tropics: (1) Coarsely deteriorated plaster is discarded. (2) "Doubtful" plaster is used very liberally in rolling bandages, and about 50% more is applied than in temperate climates. (3) Standard gauze bandage is used instead of crinolin or other wide-meshed material, in order to hold the increased plaster content. (4) Additional plaster is liberally applied during the application of a cast. (5) Reinforcements of metal or wood are frequently placed at points of stress, particularly in a hip cast. To assure drying, water at 110°–120°F. is employed in the bandage basin and a half teaspoonful of salt is added to it.

*Varieties of Plaster Paris.*—Certain French preparations of plaster<sup>1</sup> marketed in 500-gram, sealed tins are entirely free of the objections mentioned. These products are of the finest quality, and possess an added advantage in being packed in comparatively small containers. Best grade French plaster of Paris, however, is not always obtainable; and, moreover, in some countries a high import duty prohibits the economic use of this product.

*Substitute for Plaster.*—A common indication of the necessity of providing a plaster substitute is the discovery that all of the plaster on hand has deteriorated to a degree which makes its effectiveness doubtful. This experience has probably been the lot of most surgeons working in isolated localities in the tropics where quick access to a supply of fresh plaster is not always available. When such an emergency situation is encountered, fixation by splinting or extension is not always a satisfactory alternative. The writer has found that mixtures of Portland cement with starch, with certain reservations, fulfil the requirements for an emergency or semi-permanent substitute for plaster of Paris.<sup>2</sup>

*The Cement-Starch Cast.*—For most purposes, a mixture of equal parts by volume of Portland cement and laundry starch will prove satisfactory. These materials are freshly mixed, triturated if lumpy, spread thickly on a gauze bandage, rubbed smooth, and loosely rolled. The bandages are placed in warm water (salt is omitted), gently compressed to insure exit of air bubbles, and applied exactly as are plaster bandages. Cement-starch powder and water are thoroughly rubbed into the growing cast. The finished model is smoothed and polished with starch-and-water paste. Casts for the arm or leg should be at least 1 cm. thick after rubbing; and for the body, thigh and hip, they should be proportionately heavier.

For a light-weight cast, subjected to little strain, the mixture may be made of 2 parts by volume of starch to 1 part of Portland cement; while for a heavy weight cast, which may be subjected to considerable tension, the proportion may be reversed.

These casts generally require from 24 to 36 hours to become thoroughly dry and hard. New types of quick-hardening cement<sup>3</sup> materially reduce the time of "setting." During this period, immobility must be assured by coöperation of the

patient. Drying may be hastened by the application of hotwater bottles to the cast, by exposure to sun or light, by hair-drying apparatus, or by utilizing one or more 200 c.p. electric bulbs.

*Comparison of Cement-Starch with Plaster of Paris.*—Casts made in the manner suggested compare favorably with those constructed of the ordinary grades of domestic plaster of Paris or dental plaster. They are made of materials which do not deteriorate and which are always available. They are heavier, and somewhat softer, and tend to become more moist than plaster casts. They bend as readily, but are not so prone to crack. They appear to “wear” as well as ordi-



FIG. 1. CEMENT-STARCH CAST USED FOR FIXATION AND EXTENSION IN FRACTURE-DISLOCATION OF 3RD AND 4TH CERVICAL VERTEBRAE

When removed one month after application, this cast was in good condition. Composition: cement, 1 part; starch, 2 parts.

nary plaster casts and are easier to remove in either the dry or wet state. Removal is best accomplished after soaking the cast in water to soften and dissolve its starch content. The moistened cement bandage is easily cut with a cast knife or cutter.

Economically, the cement-starch cast is of decided advantage. For example, in Guatemala, the cost of Portland cement is \$0.0132 per pound, and of starch is \$0.119 per pound; while plaster of Paris (French grade) is \$0.30. Furthermore, there is a large percentage of loss from deterioration when ordinary plaster of Paris is used; and this must be taken into consideration in making an estimate of the comparative gross cost of the product.

## CONCLUSIONS

(1) Ordinary grades of plaster of Paris are subject to rapid deterioration in tropical climates, which renders them unsuitable for exacting use.

(2) High grade French plaster of Paris, packed in small containers, is stable and should be given preference when possible.

(3) Mixtures of Portland cement and starch have been used satisfactorily as substitutes for plaster of Paris. The materials are cheap and readily available, and are not subject to deterioration.

(4) The cement-starch cast compares quite favorably with casts made of the ordinary grades of plaster of Paris and is superior to those made of deteriorated plaster.

## REFERENCES

1. Plâtre a Mouler, Darrasse Frères, Paris.
2. The celluloid cast described by Ryerson is expensive and requires several days to complete. Ryerson, E. W., Jour. Bone & Joint Surg., Boston, 1926, VIII, 517-518.
3. A quick-hardening cement, of good quality, is manufactured by the International Cement Corporation.



## SECTION V

## BLOOD PRESSURE STUDIES IN THE WEST INDIAN NEGRO

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The results of these investigations are based on the examinations of groups of farm and railroad laborers and their families residing in the Panama Division of the United Fruit Company. They comprised 500 persons who showed typical characteristics of pure African origin.

Their environments do not differ materially from those of the labor class in the other Divisions of this Company; with the exception that in Panama there is an older and more stable labor force, which facilitated my investigations.

*Technique.*—As the blood pressure of a healthy person is liable to vary under different physiological conditions, the examinations were made in three groups:

Group 1 were examined in the farm labor camps, when the laborers and their families had been gathered at the different farms for the purpose of making routine malaria field-surveys. Some of the men had worked for several hours on the day of the examination, but most of them had had an opportunity to rest for at least one hour before their blood pressure was taken. In this group the blood pressure was usually determined with the patients in a sitting position; but, in some cases, in a standing position.

Group 2 consisted of Hospital Dispensary cases. Most of them had not done any work on the day of the examination, as they had to travel several hours by train to come to the Hospital Dispensary. None of them had walked very far. They also had a chance to rest for half an hour at least. All of these were examined while sitting.

Group 3 were bed patients; and most of them had been in the Hospital for several days. These were examined while lying in bed.

No selection of cases was made, other than to exclude those who had fever, and those who were severely injured or had been recently operated upon.

In 350 cases, the blood pressure was taken with a mercury manometer by palpation, as the main interest lay in the systolic pressure. In 150 cases the auscultatory method was used, in order to determine the diastolic and pulse pressure as well.

In 90 cases Dr. Dove took the blood pressure, while in the other 410 cases the examinations were done by the writer.

There were 328 men and 172 women among the 500 persons examined. Their ages varied from 16 to 80 years. The average age of all was almost 40 years

(39.9 years). The average of the women (36) was lower than that of the men ( $43\frac{1}{3}$ ). The blood pressure was considered as higher than normal when its systolic reading was over 140 mm. Hg. Based on this figure it was found that, of the 500 cases, 167 or 33.4% had hypertension.

The cases of hypertension, as they were distributed over the 10-year groups, are indicated in Table No. 1.

TABLE NO 1

Group No.	Age	Number of Examinations	Number of Hypertension Cases	Percentage of Hypertension
1	Under 21	36	2	5.5%
2	21-30	95	13	13.2%
3	31-40	138	46	33.3%
4	41-50	134	56	41.8%
5	51-60	66	33	50.0%
6	61-70	24	14	58.3%
7	Over 70	7	3	42.9%

As will be seen from the above Table, the sixth and seventh decades showed the highest rate of hypertension cases.

Taking the sex as a base, the ratio was as follows:

TABLE NO. 2

Sex	Number of Examinations	Number of Hypertension Cases	Percentage of Hypertension
Male . . . . .	328	108	32.9%
Female . . . . .	172	59	34.3%

The average age of the 108 men with high blood pressure was 47.34 years; and that of the women with hypertension, 43.74: thus, the average age of the women with high blood pressure was more than  $7\frac{1}{2}$  years above the general average for all of the women; while that of the men was scarcely 4 years above the average age of all the males.

In Table No. 3 is shown a comparison of the three groups—(1) Field-survey cases; (2) Hospital Dispensary patients; and (3) Hospital patients.

As all of the persons examined in the field and a majority of the patients examined in the Hospital Dispensary were able to work; it is obvious that, at the time of the examinations, almost 75% of the 167 people with hypertension were able to work. More than 25% of all those (167) who had a high blood pressure had not come to the Hospital for treatment during the last 5 years. Also, among the 45 bed patients showing hypertension, there were very few who had been admitted to the Hospital for complaints which could be attributed to their hypertension.

An explanation of the higher percentage of hypertension cases in Group 1 will be given later.

With the object of determining the pathogenesis which lead to the rise of the arterial blood pressure, roentgenological examination of the organs of the chest, the serum reaction for syphilis, and urine analyses, were made in the largest

possible number of cases. Fluoroscopic examinations of the thoracic organs were done on 185 cases; the blood serum was tested for syphilis in 268 cases by the Meinicke method; and clinical and microscopical examination of the urine was made in 180 instances.

In some of the definite hypertension cases, it was impossible to make the three above-named examinations. I am, however, presenting a group in which all three examinations were made; and consider the number sufficiently large to be representative of the underlying pathology.

In the 167 cases of high blood pressure, the Meinicke test was performed 121 times; and of these 66 or 54½% were positive. Of 147 cases of normal blood pressure on which the Meinicke test was made, it was positive in 57%.

A summary of the results is given in Table No. 4.

TABLE NO. 3

Group	Number of Examinations	Number of Hypertension Cases	Percentage of Hypertension
1. Field-Survey Cases . . . . .	255	91	36%
2. Hospital Dispensary (Outpatient Clinic) Cases . . . . .	103	31	30%
3. Hospital (Bed) Patients . . . . .	142	45	32%
Total . . . . .	500	167	33½%

TABLE NO. 4

HIGH BLOOD PRESSURE AND MEINICKE TURBIDITY REACTION

Blood Pressure	Number of Examinations	Number Positive	Percentage Positive
High . . . . .	121	66	54½%
Normal . . . . .	147	84	57%
Total . . . . .	268	150	55½%

The average age of the high blood pressure cases with a negative M. T. R. was 46 years; and that of the sero-positive cases was 45 years.

Before giving a detailed account of the results of the roentgenological investigations, a short resumé of the clinical symptoms of the circulatory system in the hypertension cases is herewith presented. These studies were made in a group of 45 bed patients. The general impression gained was that, in view of the far advanced pathological process as found in the heart and the aorta, the auscultation and percussion alone did not give very satisfactory results.

Enlargement of the heart was found in about half of the cases, and was seldom very marked. At the apex and at the base over the aorta, systolic murmurs were heard more frequently than diastolic; and the second aortic sound was often roughened, and not infrequently accentuated. The clinical manifestations of advanced changes in the aorta were: an increased area of dullness over the manubrium sterni; dilated cutaneous veins of the thorax; visible pulsations in the jugular and supraclavicular fossa; and differences in the radial pulse



of either side. Persistent tachycardia of a moderate degree (around 100 pulsations per minute) was much more frequent than bradycardia. While there was an average pulse pressure of 68 mm., we often found clinical heart symptoms of an aortitis. However, the classical picture of the aortic regurgitation was shown only in 3 of the 45 bed patients.

The main subjective complaints were: a burning sensation behind the sternum, and also in certain cases over the left costal margin; and obstinate paraesthesias of the skin of the thorax, occurring occasionally on the right but more frequently on the left side; neuralgic pains, for the most part radiating into the left shoulder and often extending down the left arm also, were not unusual. In 2 cases of big aneurysms of the ascending aorta; the paraesthesias were found to be limited to the right breast and shoulder region, and the neuralgias extended into the right arm.

It should be emphasized that, in spite of these symptoms which resembled very much the prodromata of angina pectoris, a genuine attack of angina pectoris has never been observed nor could a history of one be obtained from any of the patients.

TABLE NO. 5

HEART CONTOUR AND MEINICKE TURBIDITY REACTION OF 126 HYPERTENSION CASES

	Aortic Abnormal Configuration			Mitral Abnormal Configuration			Normal Heart		
	93 cases—73.5%			5 cases—4%			28 cases—22.5%		
	Meinicke Turbidity Reaction			Meinicke Turbidity Reaction			Meinicke Turbidity Reaction		
	Pos.	Neg.	Not Taken	Pos.	Neg.	Not Taken	Pos.	Neg.	Not Taken
Cases.....	52	34	7	3	2	0	11	14	3

Complaints of palpitation and shortness of breath were less frequent than the above mentioned symptoms. This might be attributed to the low degree of mentality of the patients. That they seldom complained of headache or disturbances of vision, was remarkable. Edemas of the lower extremities, together with other symptoms of a broken compensation, were found 4 times among the 45 patients. In 30 cases nocturia was present; but this symptom might be readily attributed to the chronic gonorrheal affection of the lower urinary tract—a condition of frequent occurrence in our patients. In a certain number of patients complaints of gastric distress were pronounced, which suggested occasionally the presence of Roemheld's gastro-cardiac symptom-complex. Whenever possible, the stomach was examined (including Roentgen ray); and chronic gastritis, probably of syphilitic origin, was found in a few cases.

Exact measurements of the heart and aorta were not considered necessary in our studies, as only more pronounced changes of their shape and size were of interest. Consequently, it was deemed sufficient to make fluoroscopic examinations only, using teleroentgenograms occasionally in order to check the findings.

At the same time, with the fluoroscope it was possible to examine the patients' chests at different angles; to observe normal and abnormal pulsations; and to note the condition of the diaphragm; etc.

The purpose of these examinations was to determine the shape and approximate size of the heart and the aorta. In Table No. 5 are tabulated the character of the alterations of the heart contour, in relation to the blood reaction for syphilis.

This shows that the aortic abnormality was present in almost 75% of the cases, while the mitral abnormality was very rare; and a normal-shaped heart was found in almost 25% of the cases. Further, it is evident from this table that, in the cases with an aortic abnormal configuration, the positive reactions for syphilis outnumbered the negative findings; whereas, with the normal-shaped hearts, the ratio was reversed.

In Table No. 6 is tabulated the comparative degree of enlargement of the hearts of the hypertension cases. Small, normal, and slightly enlarged hearts

TABLE NO. 6

HEART ENLARGEMENTS AND MEINICKE TURBIDITY REACTION OF 126 HYPERTENSION CASES

Group No. 1 Small, Normal, and Slightly Hypertrophied Hearts 62 cases—49%			Group No. 2 Medium Degrees of Enlargements 57 cases—45%			Group No. 3 Extreme Enlargement 7 cases—6%		
Meinicke Turbidity Reaction			Meinicke Turbidity Reaction			Meinicke Turbidity Reaction		
Pos.	Neg.	Not Taken	Pos.	Neg.	Not Taken	Pos.	Neg.	Not Taken
38	19	5	22	30	5	6	1	0

are included in Group No. 1; Group No. 2 comprises the medium degrees of hypertrophy, dilatation, or both; while in Group No. 3 are the cases of extreme dilatation, or so called *cor bovinum*.

Group No. 1 and Group No. 2 were almost equal in number; and, together, they far out-numbered the cases of extreme dilatation included in Group No. 3, which totaled only 6% of the 126 cases.

In Group No. 1 the positive Meinicke reaction was of greater frequency than the negative; in Group No. 2 it was negative more frequently than positive; and Group No. 3, with one exception, all gave the positive Meinicke reaction. The enlargements of the heart were distributed equally in the two sexes—among 84 men there were 42 or 50% cases of heart enlargement; and, among 42 women, 22 cases or 52%.

The variations in the x-ray shadows of the aorta were exceedingly large and remarkable.

In 126 cases of hypertension, 104 or 82½% showed a pathological aorta in the Roentgenogram.

They are grouped as follows:

TABLE NO. 7

	Meinicke Turbidity Reaction			
	Pos.	Neg.	Not Taken	Total
1. Diffuse enlargement of the Aorta:				
A. Isolated:				
Aorta ascendens . . . . .	10	1	0	11
Aortic arch . . . . .	3	1	3	7
Aorta descendens . . . . .	9	10	0	19
Protruding aortic bulb . . . . .	4	16	2	22
B. General:				
Ascendens, arch and descendens . . . . .	21	12	5	38
2. Aneurysms:				
Aneurysm of aorta ascendens . . . . .	5	0	0	5
Aneurysm of aorta descendens . . . . .	0	2	0	2
				<hr/>
				104

The summary of the various aortic changes, which are characteristic in arterio-sclerosis of the aorta on the one hand and syphilitic aortitis on the other, (admitting, of course, a possible combination of both processes), gave the following results:

	Meinicke Turbidity Reaction	
	Pos.	Neg.
1. Alterations of:		
Aorta ascendens . . . . .	10	1
Aortic arch (visible only in the oblique or frontal diameter) . . . . .	3	1
Aorta ascendens, aortic arch, and aorta descendens . . . . .	21	12
Aneurysm of aorta . . . . .	5	2
	<hr/>	<hr/>
	39	16

Thus, we find in the "syphilitic" group the Meinicke reaction was positive 39 times and negative 16 times.

	Meinicke Turbidity Reaction	
	Pos.	Neg.
2. Alterations of:		
Aorta descendens . . . . .	9	10
Aortic bulb . . . . .	4	16
	<hr/>	<hr/>
	13	26

In the "arteriosclerotic" group the Meinicke reaction was positive 13 times and negative 26 times.

In 180 out of the 500 cases a chemical and microscopical urine examination was performed. The value of these urine analyses was lessened somewhat because (a) only one examination was performed in the majority of the cases,



and (b) the results were obscured by the numerous gonorrheal infections and its sequelae in the urinary tract.

Those cases which showed only faint traces of albumin in the presence of a large amount of pus cells were excluded, in order to use solely the pathological findings which could be more or less definitely attributed to disease of the kidneys.

In 87 cases of high blood pressure the urine was examined, and in 60 cases pathological findings were noted which are detailed in Table No. 8.

In the 40 cases with a positive M. T. R., 26 had positive and 16 had negative urine findings; while in the 41 sero-negative cases the urine was positive in 30 cases and negative in 11 cases. In other words, of 56 patients with high blood pressure and a positive urine there were 26 sero-positive and 30 sero-negative for syphilis. Furthermore, in considering the M. T. R. results and the x-ray findings, which pointed decidedly towards syphilis on the one hand as an aetio-

TABLE NO. 8  
MEINICKE TURBIDITY REACTION AND URINE ANALYSIS

	Meinicke Turbidity Reaction			
	Pos.	Neg.	Not Taken	Total
1. Positive:				
Large amount of albumin . . . . .	4	2	0	6
Small amount of albumin . . . . .	12	18	4	34
Hyaline, granular and wax casts . . . . .	3	5	0	8
Small amount of albumin and casts . . . . .	4	5	0	9
Large amount of albumin and casts . . . . .	3	0	0	3
2. Negative . . . . .	14	11	2	27
	40	41	6	87

logical factor and to an arteriosclerotic or renal origin on the other hand, a comparison was made with the findings in the urine:

	Urine	
	Pos.	Neg.
1. Syphilitic heart and aorta shadow, and positive M. T. R. . . .	13	7
2. Arteriosclerotic heart and aorta shadow, and negative M. T. R.	22	7

It may be added here that the 7 patients of the above Group 2; in whom the blood sera reactions and the urine findings were negative and gave no indication of the condition possibly responsible for the rise in the blood pressure; were all over 50 years old, with an average age of 58 years. This suggested arteriosclerosis as the probable factor.

*Technique.*—In a critical retrospection of the results here submitted the method of taking the blood pressure will of necessity have to be explained. Dividing the patients into three groups made it possible to determine the blood pressure under different physiological conditions. It has been found<sup>1</sup> that the variations in the systolic (and diastolic) pressure response noted after exercise in normal young adults are very great. In attempting to find more significant readings, by taking the blood pressure under conditions similar to those required

for the determination of the basal metabolic rate, the so-called basal blood pressure<sup>2</sup> was found to be much lower than a reading obtained on first examination.

The patients of Group 3 (Table No. 3) were examined on the 2nd and 3rd day of their hospitalization in the morning after a night of sufficient sleep. Apart from a purgative on the day of their admission, they had not received any drugs. It may therefore be assumed that the readings obtained in this group were practically basal.

A comparison of the rate for Group 3 with the rate for Group 2 does not show any remarkable difference (both around 30%). The rate for Group 1, examined on the farms under less favorable conditions, however, greatly exceeded the rates for the other two Groups. This was especially noticeable in one place where a group of 73 railroad laborers were examined near the locality they worked and consequently had no time to rest before the test was made.

In order to check up on some of the cases of Group 1 which showed hypertension when first examined, the blood pressure examination in 27 instances were repeated in the Hospital Dispensary within the following 4 weeks. Fifteen of these showed a lower reading of the systolic blood pressure; and, in 4 cases, it had come down to within normal limits. The greatest differences were noted among those in whom the original readings were over 200 mm. systolic, though there was none of them who showed less than 140 mm. on the second examination. Rises (some of them rather considerable) were noticed in 6 instances; and 6 showed no change. The 4 persons who had a normal blood pressure on second reading did not show any sign of heart disease; the roentgenograms of the aorta were normal in all 4 cases; and 2 of them showed a slight hypertrophy of the left ventricle. Their average age was 32 years; and therefore it may be presumed that the hypertension exhibited at the time of the first examination was due to a temporary physiological rise of the blood pressure.

Several cases of this kind, which were not reexamined, might have been included in our statistics; but, if we compare the figures in the 3 Groups, one must admit that this number can not have been very great.

*Age and High Blood Pressure.*—In an extensive paper on low blood pressure, Kisch<sup>3</sup> reported 1,800 cases within age limits very similar to the series herein recorded (20–80 years) and found a high blood pressure in 34.3%. Our total average of 33.4% almost equals his rate, but significant differences are noted by comparing his and our data in the respective ten-year groupings:

TABLE NO. 9

Group No.	Age	Vienna Population	West Indian Negroes
1	2nd decade	—	5.4%
2	3rd decade	5.8%	13.2%
3	4th decade	20.5%	33.3%
4	5th decade	64.5%	41.8%
5	6th decade	54.1%	50.0%
6	7th decade	44.5%	58.2%
7	8th decade	40.8%	43.9%

Kisch's groups show a sudden rise from the 4th to the 5th decade, followed by a gradual decline. In our series of cases, the rates go up gradually until the 7th decade. The few men in the 7th Negro group (over 70 years) have to be regarded as "survivors of the fittest."

*Pathogenesis of High Blood Pressure.*—If we consider in this connection the pathogenesis of high blood pressure, it would appear to the writer that the gradual increased ratio of our hypertension cases with age, favors the belief that the condition may be due to aetiological factors which have been developing insidiously from an early age.

Considering the fact that the M. T. R., which is certainly not one of the most sensitive reactions for syphilis, was positive in more than half of the cases, and that in the late stages of syphilis the blood serum reaction is not necessarily always positive, we may safely conclude that 2 out of 3 individuals were infected with syphilis. I am of the opinion that, among the aetiological factors of our cases of hypertension, syphilis can claim first place. Congenital infection with syphilis shows in the generation on which this paper is based a much greater incidence than we observe today in newborns and small children. This is probably due to the fact that, during the last few years, a comparatively much larger percentage of the female population have submitted to anti-luetic treatment. (The only 2 cases of hypertension found in the group under 20 years were two girls, 15 and 18 years of age—both of whom were congenital syphilitics).

The post-natal infection with lues is acquired, in the majority of the cases, early in the second decade. Skin affections typical of the secondary stage are rarely observed in this locality. Tertiary luetic manifestations are most common; but, even here, the skin eruptions are less frequently observed than the visceral (including the central nerve system) lesions.

Smith and Kimbrough<sup>4</sup> described syphilitic heart disease with failure, observed in a well examined group of 56 patients (white and black). They estimated, from their observations, that syphilitic heart disease occurred one and one-half times as frequently in syphilitic negroes as in syphilitic whites. Also, they found that the average age of the negroes was seven years less than that of the whites. From this fact, they also concluded that a greater susceptibility to cardiovascular involvement from syphilis exists in the colored race. In my opinion, the latter merely seems to point to an earlier primary infection in the individual.

In 59% of their cases they found aortic regurgitation; in 31%, dilatation of the aorta; in 32%, aneurysm. The average systolic blood pressure was 145 mm., the diastolic pressure 74 mm., (pulse pressure 71 mm.).

In the syphilitic negroes included in our series, the rise of the blood pressure may have had its origin from a syphilitic involvement of the arteries or the kidneys.<sup>5</sup>

*Syphilitic Aortitis.*—According to Matthes,<sup>6</sup> the uncomplicated luetic aortitis does not produce a rise of the blood pressure. Under the term "uncomplicated aortitis," he includes the *aortitis supracoronaria* of Schottmueller in which the



aortic valves are not involved. I also have found that the syphilitic aortitis does not necessarily produce hypertension in every case. I examined by x-ray, 59 patients with a normal blood pressure, compensated heart and a positive M. T. R.; and found, in 14 instances, syphilitic alterations of the aorta. With the exception of 4 cases, however, the lesions were of a mild degree and the term *aortitis supracoronaria* might well have been applied to them.

But if we exclude these initial stages we must, in all cases of advanced aortitis, expect an increased strain upon the heart; and as there are always simultaneous involvements of the smaller arteries of the viscera, a rise then results in the blood pressure. Moreover, we may assume that in the majority of the cases with structural abnormalities in the ascending part of the aorta, a relative insufficiency of the aortic valves had existed even before an anatomical lesion was present in them.

Based on model experiments which he undertook in continuation of the works of Krehl, Hesse and others, Hochrein<sup>7</sup> proved that in the normal heart and aorta a physiological regurgitation already exists. This is increased when the heart is weak and the aortic pressure elevated.

Finally, if we consider the far advanced stages of aortitis observed in the cases which we examined by x-ray, and how often a chronic valvulitis of the aortic valves has been found in autopsies of syphilitic negroes,<sup>8</sup> we can assume with certainty that in the greater number of cases an *aortitis valvularis* with its sequelae did exist.

*Kidney Diseases.*—The urine examinations revealed more frequently the presence of small than of large amounts of albumin. Thus the possibility exists that, in a certain number of cases, a passive congestion due to a cardiac disturbance was the cause of these findings. However, the same conditions are observed rather frequently in our wards in negroes whose circulatory system is not disturbed. The status of these patients is characterized by a urine of low specific gravity; faint or heavy traces of albumin, often accompanied by casts (mostly hyaline); and the nearly constant absence of edemas and uremic symptoms. Hypertension is found in about half of the cases. These conditions may, as I have observed from our clinic card system, exist over years without apparent definite changes, until an intercurrent disease such as malaria, pneumonia, or amebic dysentery provokes an acute exacerbation. Then, in addition to an increase in the amount of albumin and the appearance of numerous granular and hyaline casts, edemas and uremic symptoms may supervene. In cases of lobar pneumonia, these conditions are especially to be dreaded, as they often determine the results.

It is, however, not infrequently seen that, after a recovery from the intercurrent illness, the kidney symptoms resume their former character. How far syphilis can be held responsible for these chronic conditions of the kidneys in the adult negro can hardly be decided by the symptoms alone. At least, the large amounts of albumin and marked edemas, which authors described as typical for syphilis of the kidneys, are never observed. Only in theluetie babies

and infants did we occasionally find large amounts of albumin with edemas. In the past, congenital syphilis was undoubtedly more prevalent than now; and the possibility exists that the renal conditions observed in the adult negro are residuals of kidney diseases from the early stages of congenital syphilis. I found the most severe cases of nephritis, in some congenital luetic persons between 15 and 20 years who died with the symptoms of uremia and with hypertension. Cases in which these above-mentioned kidney symptoms were found associated with other symptoms of syphilis have sometimes shown a definite improvement of the renal symptoms after treatment with potassium iodide and neosalvarsan.

Of course there are, aside from syphilis, all the other aetiological factors of a bacterial, physical or chemical nature to be taken into consideration as causative factors of nephritis in our negroes. However, I want to emphasize that the clinical picture of a glomerular nephritis in the negro is rarely found here.

In 15 instances, Dr. F. B. Mallory, of Boston, has rendered pathological reports on diseased kidneys from negroes who were autopsied in the Almirante Hospital. He found in 3 instances an acute nephritis—1 glomerular, 1 tubular, and 1 diffuse. Chronic nephritis was observed 12 times; edema and congestion of the tubular structure, 6 times; nephrosclerosis or chronic vascular nephritis, 3 times; and, finally, sclerosis of the kidneys combined with edema of the tubules and stroma, 3 times.

*Heart; Shape and Size.*—In cases of uncomplicated luetic aortitis, the heart is usually described as being of normal size. But, as in all instances we had to deal with hypertensive persons, whose valvular apparatus was damaged in the majority of the cases; it is plausible to assume that the cases of cardiac enlargement were more numerous than those which showed a heart of normal size because: "All conditions which cause greater muscular effort of the heart will produce a hypertrophy of the heart."<sup>9</sup> This was proved by our x-ray findings as shown in Table No. 6. Also, besides this hypertrophy, there is in many cases a continuation of the mesaortitis into the coronary arteries producing a severe degeneration of the heart muscle, manifested in our patients with a broken compensation. Fifty per cent of them proved fatal; and real recoveries were very unusual.

*Arteriosclerosis.*—Arteriosclerosis is a common occurrence among our negro population. I have mentioned already the arteriosclerotic changes in the aorta. Arteriosclerosis of the peripheral vessels, such as hard tortuous arteries of the extremities; and the pericorneal capillary changes, known as *arcus senilis*, are also frequently seen. The microscopical examinations of the kidneys have shown, in addition to these changes, the occurrence of genuine nephrosclerosis.

*Essential Hypertension.*—*Essential hypertension* is at present defined as a permanent rise of the blood pressure, the cause of which is still more or less unknown.

I endeavored to find among our negro patients with high blood pressure, the cases which might be regarded as primary hypertension, by selecting those who showed negative urine findings, a negative M. T. R., and a normal picture of the

aorta in combination with a hypertrophic but otherwise normal heart. This condition was found 4 times. Two were women at the menopause; while the other 2 were men of 35 and 42 years of age, respectively. I could not find an organic cause for their hypertension, which did not rise above 155 mm.

In all the other instances, it was possible to find syphilitic or arteriosclerotic blood vessel changes, or a chronic kidney disease; and these are factors which, for many years, have been considered to have a causative relationship with hypertension.

Whereas in the past these diseases, manifesting their changes in the small arteries, were *alone* recognized as aetiological factors for the increased blood pressure, recent studies have shown vascular spasms<sup>10</sup> of hitherto ill-defined origin to be of importance in the aetiology of hypertension. These observations were made in the big cities of the highly civilized countries of Europe and the United States of America.

*Hypertension and Apoplexia.*—Jaffe,<sup>11</sup> based on studies of Westphal and of his own, discusses the question of the connection between essential hypertension and apoplexia; and forms the conclusion that, "In the aetiology of apoplexias vascular spasms are of great importance," and that in the majority of cases the hypertension (still of unknown origin) is the causative factor for these spasms.

The average number of admissions of adults (over 16 years of age) to the Almirante Hospital during the last 5 years (1924–1928) was 2,569 per annum. The number of cerebral hemorrhage (not classified) averaged between 4 and 5 per annum. In other words, while about 1 out of 3 adult negroes had hypertension, 1 out of 584 patients suffered from apoplexy. I regret that I have been unable to procure any comparative data from a white population. It is certain, however, that apoplexia is a rare occurrence among our negro and native population.

In his paper Jaffe points out the importance of the frequent occurrence of angiospastic insults (Kauffman) in people with hypertension, among which angina pectoris ranks first. Anatomical changes in the coronary arteries, as well as in the ascending aorta, have heretofore been held responsible for the pathogenesis of angina pectoris. Recently vascular spasms are believed to be of greater importance than these anatomical changes.<sup>12, 13, 14</sup> Among the large number of diseases in the ascending part of the aorta, we should have expected in a certain number of our cases typical attacks of angina pectoris; but as I have already pointed out, I never observed one nor did any of the patients give a history of having had an attack.

In the statistics for the last 5 years (1924–1928) of the Medical Department of this Company, I found among an average of more than 27,000 hospital admissions per annum of natives of Central America and the West Indies (including persons of the negro race) a total of only 8 cases in 5 years diagnosed as angina pectoris—i.e., the number of such cases was less than 6 per 100,000 admissions. However, statistics for other angiospastic conditions—as, for instance, intermit-



tent claudication and abdominal angina—are completely lacking as they were not recorded separately.

In this connection the results of the investigation of Donnison,<sup>15</sup> who examined 1,000 negroes in Kenya Colony, are very interesting:

No instance of raised blood pressure was encountered, though abnormally low blood pressure was not uncommonly noted. On no occasion was a diagnosis of arteriosclerosis or chronic interstitial nephritis made. One case was seen in which the history was suggestive of angina pectoris, but no abnormality was detected on examination. Occasional cases of hemiplegia were observed; but those which Donnison had the opportunity of investigating, suggested that relapsing fever might have been the cause. Aortic incompetence was of syphilitic origin. Hypertrophied hearts without intrinsic cardiac disease were rarely seen. Atheroma in the aorta was seen much less frequently in the native African than in the average European of the same age. His investigations lead him to the conclusion that hyperpiesis and arteriosclerosis are diseases associated with civilization.

The results of our studies are not published with the object of supporting any particular one of the numerous theories about the pathogenesis of hypertension, though they throw a certain light upon this interesting condition in the black race. It appears to the author to be of practical importance to point out again the frequency of diseases of the circulatory system in a working negro population, and to emphasize the fact that hypertension occurring in this race is almost exclusively based on cardiovascular or cardiorenal disturbances.

#### SUMMARY

The arterial blood pressure of 500 West Indian negroes of an average age of 40 years was determined; and 167 or 33.4% showed a systolic pressure above 140 mm. and an average pulse pressure of 68 mm. No marked differences were found between men and women, regarding the distribution of hypertension cases. Besides the determination of the blood pressure; in the greater number of the cases clinical and Roentgen ray examinations, urine analyses, and blood serum reactions for syphilis (Meinicke Turbidity Reaction), were also made.

The M. T. R. gave positive results in 55½% of all cases, in 54½% of the hypertension cases, and in 57% of the normal blood pressure cases.

*The Cases With Hypertension Showed Further.—*

In 73½%, an aortic configured heart

In 4%, a mitral heart

In 49%, small, normal or slightly enlarged heart

In 45%, medium degree of cardiac enlargement

In 6%, extreme enlargement of the heart

Broadening of the Roentgen ray shadow in 82½%, with the syphilitic prevalence over the arteriosclerotic type.

In 69%, pathological urine findings which pointed towards a kidney disease.

The investigations showed that in the large majority of the cases with hyper-

tension, a syphilitic aortitis and endocarditis, arteriosclerosis, and chronic kidney diseases were present; whereas cases of angina pectoris and apoplexias were almost completely absent.

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## DISEASES OF THE EYE IN HONDURAS

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## PRELIMINARY REMARKS

The following report is based upon four months work in the Hospital of the Tela Railroad Company at Tela, Honduras, and three months in the Hospital of the Truxillo Railroad Company at Puerto Castilla, Honduras. The patients treated are classified according to whether they were born in the temperate zone or elsewhere. As will be seen in the statistical summary, patients from the temperate zone consulted me mainly because of refractive errors while those from the tropical zone were seeking treatment for diseases of the eye other than refractive errors.

From the standpoint of industrial disability, the two most important eye conditions are acute catarrhal conjunctivitis and foreign bodies. The latter cases, while they are still rather frequent, are less than in former years because of the more widespread use of guards over emery wheels and other safety devices, and because of the more general use of protective goggles in the shops.

*Acute catarrhal conjunctivitis* continues to be the principal cause of disability among eye diseases, and in fact ranks among the four or five most prevalent diseases encountered in medical practice in Tela and Castilla. As can be seen from the Annual Report, it is one of the most common causes for admission to the Hospital, and also accounts for a relatively large percentage of the cases treated in the dispensaries.

Of the cases classified as diseases of the eye, the majority were acute catarrhal conjunctivitis. These cases have been studied bacteriologically in Tela; and most of the cases have been found to be due to the Koch-Weeks bacillus, although a small percentage are due to the pneumococcus and to the Morax-Axenfeld bacillus. This affection (which is relatively mild in temperate climates), is mild here only in the sense that it responds readily to treatment. Untreated or improperly treated cases develop all of the complications ordinarily associated with gonorrheal conjunctivitis. These are: severe scarring of the cornea, hypopyon, perforating ulcers, iritis, secondary glaucoma, and panophthalmitis. The last named is, however, rare even following the perforation of an ulcer. Acute catarrhal conjunctivitis is endemic in the Tela and Castilla Divisions, and at times assumes epidemic proportions. Its continuance is favored by the presence in the labor camps of women and children who have the disease but do not come to the Hospital for treatment. Treatment is simple and effective; and consists of continuous iced boric acid compresses, and the instillation every two or three hours of argyrol, 20%, protargol, 3%, or mercurochrome, 2%. The silver preparations are probably the most effective. The lids should be kept clean of secretion; but usually the cold boric compresses are sufficient for this. If an ulcer develops, it is best treated by touching it with the actual cautery; and for this purpose a squint-hook, heated in the flame, serves very well. Should keratitis, iritis or hypopyon develop, a foreign protein injection (5-10 c.c. fresh sterile milk intramuscularly) is indicated. Other complications should be treated surgically. However, before attempting any surgical procedure it is well to wait until there is no further secretion present and a conjunctival smear is negative for micro-organisms.

*Follicular conjunctivitis*.—This is a not infrequent affection among the children in Tela, and more especially in Castilla. It is probably more prevalent than is commonly supposed, because it occurs at times with apparently no subjective symptoms and no redness of the eyes. It is more common in children of the lymphatic constitution, but occurs also in children who are otherwise quite healthy. Authorities have ascribed a lack of fresh air and sunshine as causal factors of this condition; but this is certainly not the case amongst the children here, where they have an abundance of both. In those cases examined bacterio-



logically, no organisms other than the usual saprophytes of the conjunctiva have been found.

*Trachoma*.—Five cases of this disease are recorded in this report; but this figure does not give a true picture of the incidence of this affection, as most of the cases occur in adults who now have the disease in the cicatricial stage, and have either no symptoms or are so accustomed to the ones they do have that they do not seek medical aid. All of the cases, with one exception, occurred amongst Syrians who acquired the disease in Palestine; and this exception was a Syrian child born in Honduras who probably acquired the disease from adult members of the family. So far, no cases have been observed amongst Hondurans. This may indicate a natural immunity on their part; but it is unlikely. The probable explanation lies in the fact that there is very little intimate contact between the Syrians and the nationals of the country. Conditions for the spread of trachoma—lack of personal hygiene, and crowding—are favorable in Honduras; and the continued influx of these affected persons into the country constitutes a serious menace from the standpoint of public health.

*Phlyctenular conjunctivitis* is quite rare even amongst the poorest classes. Only two cases were seen, both in young undernourished individuals living on a faulty diet. Both cases were quite mild. I think we may safely attribute the rarity of this affection to the continuous, abundant sunlight.

*Quinine Amblyopia*.—One patient was observed who had suffered from quinine amblyopia about eight years ago. According to his history, for about 48 hours following the onset of the attack he did not have even light perception. At present his central vision with correcting glasses is good but not absolutely normal—O. S., 6/6 (−2); O. D., 6/6 (−2). His visual fields show a marked concentric contraction. As a result, in spite of his good central vision, he frequently stumbles over steps and other objects unless he is careful to turn his eyes well downward.

*Pterygium*.—Fifty-seven cases of pterygia were observed—an unusually high incidence which I think can be attributed to the irritating effect of heat, brilliant sunshine, and dust during the dry season. The incidence is higher in the elderly than in the young; but many cases were seen in young adults (18–23 years). A bilateral pterygium in each eye was seen in a young man of twenty. It is mentioned in all accounts of pterygium that vision is impaired when the growth reaches the pupillary area. As a matter of fact, vision is impaired long before the pterygium reaches the pupillary area because of the astigmatism produced by it. A pterygium is not a new growth in the sense that a tumor is. Rather it should be considered as a tongue of conjunctiva which is pulled across the cornea; and, as the head advances towards the pupil, the conjunctiva behind is pulled upon—even sometimes to the extent of displacing the caruncle several millimeters. In a like manner, the cornea is put under tension and its surface distorted. This distortion results in the production of astigmatism with the rule, together with some irregular astigmatism. On retinoscopy one sees the astig-

matic band in the vertical axis which, instead of being straight, is curved with its concavity directed towards the pterygium. In cases where the pterygium encroaches on the pupillary area; the pupil, on being viewed with the retinoscope, looks dark except for a narrow crescent of light at the temporal edge. Because of the associated irregular astigmatism it is possible to correct only part of the optical defect with cylinders. In the case of small pterygia, the astigmatism may be only slight or absent. When they approach the pupillary area the astigmatism may amount to several diopters, and in one case of bilateral pterygium the astigmatism amounted to seven diopters. This patient's uncorrected vision prior to operation was 20/200 uncorrected; with +7.00 cylinder axis 90° vision was 20/20. Two weeks following operation, without any correction, he could see 20/50.

The usual operation done in these cases was transplantation upwards—upwards, because in this way the mass formed by the transplanted pterygium was concealed by the upper lid. Where the pterygium was small and distensible, no liberating incisions were made after freeing it from the cornea. Where liberating incisions were necessary, one vertical incision was made downward and on a tangent to the cornea. The anesthetic used was four instillations of one drop each of five per cent. cocaine solution, and 1 to 1,000 adrenalin solution, respectively, five minutes apart. Some ophthalmologists object to using adrenalin because of its blanching effect on the pterygium; but this has seemed to us an advantage rather than a handicap. In the case of a large pterygium, it is advisable to inject about  $\frac{1}{3}$  c.c. of two per cent. novocaine beneath it; as a large pterygium is made up in part of conjunctiva from the cul de sac and near the caruncle, and this portion of the conjunctiva is exceedingly difficult to anesthetize by instillations alone.

In all cases where it appeared that the removal of the pterygium would cause much scarring of the cornea, with its disfiguring whiteness; the abraded portion of the cornea was stained for three minutes with five per cent. gold chloride, which gives an excellent cosmetic result. If care is taken that no excess of gold chloride is allowed to come in contact with the surrounding conjunctiva, the post-operative reaction is but little more than one gets when the gold chloride is not used. The eye is bandaged and the dressing changed daily. Fluorescein should be instilled daily; and, when it no longer stains the cornea, the bandage may be removed. The suture material of choice is black silk; however, in nervous patients, where we anticipate difficulty in removing the sutures, 00 chromic catgut may be used.

*Dendritic Ulcer.*—Three cases of this affection were seen, and these were patients who did not have malaria nor any of the signs of chronic malarial infection. Text books, quoting Kipp as an authority, state that chronic malaria is one of the causes of dendritic ulcer. During the past two years many cases of malaria were examined for various eye complaints, and in no instance was dendritic ulcer encountered. One of the cases of dendritic ulcer mentioned that he had felt "feverish" several days before the eye trouble began; while another said he

had had a "cold," but examination of their bloods revealed no malarial parasites. While this evidence against malaria being a causal factor of the dendritic ulcer is not conclusive, it at least seems likely that this is another of the many instances of distinct clinical entities being charged to malaria on insufficient evidence.

## STATISTICAL SUMMARY

*Refractions*

	Castilla	Tela
Employees, Temperate . . . . .	50	56
Employees, Others . . . . .	56	91
Non-employees, Temperate . . . . .	10	18
Non-employees, Others . . . . .	64	93
Total . . . . .	<u>180</u>	<u>258</u>

*Refractive Errors:*

Emmetropia . . . . .	1	8
Hyperopia . . . . .	19	48
Myopia . . . . .	5	8
Simple hyperopic astigmatism . . . . .	24	27
Compound hyperopic astigmatism . . . . .	94	107
Simple myopic astigmatism . . . . .	5	11
Compound myopic astigmatism . . . . .	19	33
Mixed astigmatism . . . . .	13	16
Presbyopia (associated with one of the above) . . . . .	57	76

*Patients Having Eye Diseases Other Than Refractive Errors*

Employees, Temperate . . . . .	14	9
Employees, Others . . . . .	44	134
Non-employees, Temperate . . . . .	6	3
Non-employees, Others . . . . .	27	75
Total . . . . .	<u>91</u>	<u>221</u>

*Diseases of the Lids:*

Hordeolum . . . . .	—	1
Entropion . . . . .	1	2
Blepharitis . . . . .	—	4
Chalazion . . . . .	10	11
Meibomian glands, concretions of . . . . .	2	—
Xanthelasma . . . . .	—	1
Foreign body in . . . . .	1	1

*Diseases of the Conjunctiva:*

Subconjunctival hemorrhage . . . . .	2	4
Conjunctivitis, follicular . . . . .	2	5
" acute catarrhal . . . . .	2	26
" chronic catarrhal . . . . .	6	6
" phlyctenular . . . . .	—	2
" gonorrheal . . . . .	1	2
Trachoma . . . . .	1	4
Conjunctiva, nevus of . . . . .	1	1
" cyst of . . . . .	—	2
" laceration of . . . . .	—	1
" foreign body in . . . . .	1	7



	Castilla	Tela
Pterygia . . . . .	24	33
Pinguecula . . . . .	1	3
Contracted socket (post enucleation) . . . . .	2	—
<i>Diseases of the Cornea:</i>		
Ulcer, catarrhal . . . . .	1	5
“ dendritic . . . . .	—	3
“ hypopyon . . . . .	—	1
“ perforating (recent) . . . . .	—	1
“ perforating (old) . . . . .	5	1
Keratitis, interstitial . . . . .	1	4
“ other . . . . .	1	—
“ actinic . . . . .	—	1
“ superficial punctate . . . . .	1	1
“ traumatic . . . . .	—	1
Cornea, scars of . . . . .	9	7
“ filtrating scars of . . . . .	2	—
“ burn of . . . . .	—	2
“ lye burn of . . . . .	—	1
“ staphyloma . . . . .	1	1
“ hyaline degeneration of . . . . .	1	—
“ perforating injury of (recent) . . . . .	2	2
“ perforating injury of (old) . . . . .	4	3
“ abrasion of . . . . .	1	2
“ foreign body in . . . . .	8	24
<i>Diseases of the Iris and Ciliary Body:</i>		
Iritis, acute . . . . .	1	4
“ chronic . . . . .	—	1
Uveitis, acute . . . . .	3	4
“ chronic . . . . .	3	7
Iris, atrophy of . . . . .	—	1
<i>Diseases of the Lens:</i>		
Cataract, senile . . . . .	24	10
“ congenital . . . . .	3	2
“ traumatic . . . . .	5	1
“ complicated . . . . .	3	5
Aphakia (post-operative) . . . . .	1	4
“ (traumatic) . . . . .	1	—
<i>Diseases of the Optic Nerve:</i>		
Optic neuritis . . . . .	—	1
Retrobulbar neuritis . . . . .	2	—
Multiple sclerosis . . . . .	—	1
Amaurosis of undetermined origin . . . . .	1	—
<i>Diseases of the Chorioid and Retina:</i>		
Macular chorio-retinitis, old . . . . .	7	2
“ “ recent . . . . .	—	1
Embolus of central artery . . . . .	1	—
Chorioiditis, other . . . . .	1	6
Detachment of retina . . . . .	4	2
Albuminuric retinitis . . . . .	—	1
Pre-retinal hemorrhage . . . . .	1	—
Commotio retinae . . . . .	—	1
Quinine amblyopia . . . . .	—	1

	Castilla	Tela
<i>Diseases of the Sclera:</i>		
Episcleritis . . . . .	—	5
Scleritis, traumatic . . . . .	—	2
<i>Diseases of the Globe:</i>		
Pthisis bulbi . . . . .	1	2
Glaucoma, chronic, simple . . . . .	10	5
“ “ congestive . . . . .	—	6
“ secondary . . . . .	2	1
Panophthalmitis . . . . .	1	—
<i>Diseases of the Orbit:</i>		
Dermoid cyst . . . . .	—	2
Retro-bulbar tumor . . . . .	—	1
<i>Diseases of the Muscles:</i>		
Paralysis of extraocular muscles . . . . .	1	1
Squint, convergent, constant, comitant . . . . .	4	2
“ divergent, constant, comitant . . . . .	3	4
“ divergent, occasional . . . . .	1	2
<i>Diseases of the Lachrymal Apparatus:</i>		
Lachrymal gland, cyst of . . . . .	—	1
Dacryocystitis, chronic . . . . .	1	2
Lachrymal duct, obstruction of, congenital . . . . .	1	—
<i>Operations Performed</i>		
<i>Lids:</i>		
Ectropion, plastic for . . . . .	—	1
Foreign body of, removal . . . . .	1	1
Chalazion, incision of . . . . .	1	4
“ excision of . . . . .	6	3
Meibomian concretions, removal of . . . . .	2	—
Scarring of, plastic for . . . . .	—	1
<i>Lachrymal Apparatus:</i>		
Lachrymal gland, cyst of, extirpation of . . . . .	—	1
“ ducts, probing of . . . . .	6	6
<i>Conjunctiva:</i>		
Cyst of, excision of . . . . .	—	2
Nevus of, excision of . . . . .	1	1
Foreign body of, removal of . . . . .	1	5
Follicles of, expression of . . . . .	—	4
Contracted socket, plastic for . . . . .	2	—
Conjunctival flap . . . . .	3	—
Pterygium, transplantation of . . . . .	13	21
“ excision of . . . . .	2	2
<i>Cornea:</i>		
Foreign body of, removal of . . . . .	8	24
Staining with gold chloride . . . . .	4	10
Ulcer of, curettage . . . . .	—	4

	Castilla	Tela
<i>Lens:</i>		
Cataract, extraction with iridectomy . . . . .	8	4
“ linear extraction . . . . .	—	1
Capsulotomy . . . . .	1	—
<i>Iris:</i>		
Prolapse of . . . . .	1	2
Iridectomy, optical . . . . .	2	2
“ basal, for glaucoma . . . . .	2	—
<i>Globe:</i>		
Enucleation . . . . .	1	2
Evisceration . . . . .	1	—
<i>Sclera:</i>		
Elliott trephine for glaucoma . . . . .	—	1
LeGrange sclerectomy for glaucoma . . . . .	2	3
Posterior sclerotomy . . . . .	1	—
<i>Orbit:</i>		
Dermoid cyst of, extirpation of . . . . .	—	2
<i>Muscles:</i>		
External rectus, recession of . . . . .	3	3
“ “ resection of . . . . .	—	1
Internal rectus, recession of . . . . .	—	2
“ “ tucking of . . . . .	1	1

## RENAL ANOMALIES DISCLOSED BY AUTOPSY\*

(4215 CONSECUTIVE AUTOPSIES)

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Congenital malformations of a major or minor degree were relatively common in the kidney, its pelvis, ureter and vessels. They seldom, however, appear to have caused any inconvenience to the individuals in whom they were found.

It is conceivable, nevertheless, that some forms of the defects found might cause serious confusion in the physical examination of the abdomen and pelvis, in the study of the renal function by catheterization of the ureter, and in radiographic interpretations.

I present for analysis 62 cases which showed one or more congenital defects and these cases were taken from a series of 4,215 consecutive autopsies performed by me with the exception of a group of 524 cases (A-5090 to A-5613). There was no sustained effort, in all cases, to clearly expose by dissection the renal

\* From The Board of Health Laboratory, Ancon, Canal Zone.



vessels and ureters close to the hilum; but changes in the ureter beyond this point could hardly have escaped observation, since it has been the practice to remove the kidneys, ureters and pelvic genito-urinary organs en mass and then to catheterize the ureters from the lower end. Some form of a renal anomaly was found in 1.47 per cent of the cases examined. .

The rise and fall of enthusiasm in searching for such anomalies at autopsy, as well as a fair idea of the true incidence of renal defects, is shown by the following tabulation of the 62 cases:

1st defect recorded in A-2057.	A series of 354 cases.	32nd defect recorded in A-4730.	A series of 88 cases.
2nd " " " A-2411.	" " " 20 "	33rd " " " A-4734.	" " " 4 "
3rd " " " A-2431.	" " " 20 "	34th " " " A-4736.	" " " 2 "
4th " " " A-2503.	" " " 72 "	35th " " " A-4750.	" " " 14 "
5th " " " A-2543.	" " " 40 "	36th " " " A-4755.	" " " 5 "
6th " " " A-2590.	" " " 47 "	37th " " " A-4758.	" " " 3 "
7th " " " A-2721.	" " " 131 "	38th " " " A-4759.	" " " 1 "
8th " " " A-3101.	" " " 380 "	39th " " " A-4920.	" " " 161 "
9th " " " A-3146.	" " " 45 "	40th " " " A-4926.	" " " 6 "
10th " " " A-3181.	" " " 35 "	41st " " " A-4930.	" " " 4 "
11th " " " A-3240.	" " " 59 "	42nd " " " A-4932.	" " " 2 "
12th " " " A-3296.	" " " 56 "	43rd " " " A-4955.	" " " 23 "
13th " " " A-3364.	" " " 68 "	44th " " " A-5079.	" " " 124 "
14th " " " A-3373.	" " " 9 "	45th " " " A-5256.	" " " 177 "
15th " " " A-3382.	" " " 9 "	46th " " " A-5482.	" " " 226 "
16th " " " A-3383.	" " " 1 "	47th " " " A-5591.	" " " 109 "
17th " " " A-3395.	" " " 12 "	48th " " " A-5651.	" " " 60 "
18th " " " A-3408.	" " " 13 "	49th " " " A-5678.	" " " 27 "
19th " " " A-3422.	" " " 14 "	50th " " " A-5729.	" " " 51 "
20th " " " A-3423.	" " " 1 "	51st " " " A-5732.	" " " 3 "
21st " " " A-3478.	" " " 55 "	52nd " " " A-5761.	" " " 29 "
22nd " " " A-3491.	" " " 13 "	53rd " " " A-5768.	" " " 7 "
23rd " " " A-3630.	" " " 139 "	54th " " " A-5815.	" " " 47 "
24th " " " A-3856.	" " " 226 "	55th " " " A-5836.	" " " 21 "
25th " " " A-3951.	" " " 95 "	56th " " " A-5848.	" " " 12 "
26th " " " A-4147.	" " " 196 "	57th " " " A-5938.	" " " 90 "
27th " " " A-4196.	" " " 49 "	58th " " " A-5971.	" " " 33 "
28th " " " A-4205.	" " " 9 "	59th " " " A-6160.	" " " 189 "
29th " " " A-4508.	" " " 103 "	60th " " " A-6210.	" " " 50 "
30th " " " A-4618.	" " " 310 "	61st " " " A-6266.	" " " 56 "
31st " " " A-4642.	" " " 24 "	62nd " " " A-6271.	" " " 5 "

*Race.*—Approximately 78 per cent. of the individuals in the series of autopsies were West Indian negroes, 12 per cent. Panaman, and 8 per cent. North American or European white races. About 2 per cent. were Orientals (yellow races).

*Age.*—The bulk of them were either 20 to 40 years of age, or 6 months to 3 years of age.

*Sex.*—A vast majority of them were males.

#### THE 62 CASES WITH RENAL DEFECTS

*Race.*—West Indian negroes in 44 cases, Latin-Americans in 10 cases, white races of North America and Europe in 8 cases.

	Race Incidence in 4215 Autopsies	Race Incidence in the 62 cases
West Indian Negroes . . . . .	78%	70.9%
Latin Americans . . . . .	12%	16.1%
North Americans and Europeans . . . . .	8%	12.9%
Orientals. . . . .	2%	0.0%

It would appear that race bears little relationship to congenital malformations.

*Age.*—The unimportance of most variations found is shown by the fact that longevity was not influenced in most of the cases by the presence of the defect.

Note the following table:

Birth to 6 months of age. . . . .	5 cases
6 months to 3 years of age. . . . .	4 "
3 years to 10 years of age. . . . .	1 "
10 years to 15 years of age. . . . .	2 "
15 years to 20 years of age. . . . .	1 "
20 years to 30 years of age. . . . .	16 "
30 years to 40 years of age. . . . .	13 "
40 years to 50 years of age. . . . .	10 "
50 years to 60 years of age. . . . .	5 "
60 years and over. . . . .	5 "

### A SUMMARY OF THE ANOMALIES

A classification of the defects is difficult, since a kidney abnormal in one respect was almost sure to be abnormal in several other respects. An attempt is made to follow Dorland's<sup>1</sup> scheme in the discussion of the cases:

#### I. VARIATIONS IN FORM AND SIZE:

*Lobulation.*—Extreme fetal lobulation in an adult kidney, excepting the congenital cystic kidney, was recorded in two of the cases.

*Hypertrophy.*—Congenital hypertrophy was, as a rule, marked in those instances where there were multiple arteries supplying a kidney, where the opposite organ was a congenital rudiment, where multiple ureters existed, and in the fused or horseshoe renal masses.

*Atrophy of One Kidney (Rudimentary Kidney).*—There was a congenital absence of one kidney in two of the cases.

*Extreme Congenital Atrophy* (small fibro-cystic nodule) was found on one side in four additional cases. From all practical standpoints, they might have been considered as absent.

*Marked Congenital Differences* in size was found in 10 more cases of the series.

*Congenital Cystic Kidneys*, unilateral or bilateral, occurred in 6 additional cases. This was noted on both sides in three cases, on the left side in two cases, and on the right side in one case.

*Other Extreme Variations in Form.*—The "horseshoe" or fused kidneys appeared in 7 cases. Three of these presented the large U form, with their right and left arms in normal position but the compound hilum presented slightly anterior and upward. Three more of them occurred as fused lower poles with the upper poles in such close proximity that they formed an acute angle or V-shape. The hilum in these cases also presented anteriorly.

There was one case of "sigmoid kidney" or a tandem fusion with both kidneys lying on the right side of the median line—the lower pole of the normal right kidney being fused to the upper pole of the misplaced left organ.

The discoid and flattened kidney occurred on both sides in 6 cases—the organs in these cases having more the shape of a spleen than the normal renal shape.

There was one unilateral occurrence of a distinctly flattened C-shaped kidney; and another single occurrence of a case with a ball-shaped renal mass on one side.

## II. VARIATIONS IN NUMBER:

No case in the series revealed an absence of both kidneys, although 47 autopsies were performed on fetuses, and nearly as many on infants dying within the first 48 hours after birth.

An absence of one kidney was found in two individuals; once on the right side, and once on the left side.

The solitary or doubled renal mass-horseshoe kidney occurred, as already stated, in 7 cases.

In one of these fused masses, there was a pedunculated mass projecting from the left arm that appeared to represent an abortive attempt at an accessory renal mass.

## III. VARIATIONS IN LOCATION (DYSTOPIC OR ECTOPIC KIDNEY):

Left organ on right side and its upper end fused to the lower end of the right kidney, in one case.

No example of the mural kidney was encountered.

The pelvic kidney, either as a unilateral or as a bilateral fused affair, occurred 13 times.

Locations of one or both organs between the normal position and the pelvis were noted twice.

## IV. FUSION OF KIDNEYS:

Horseshoe kidneys occurred in 7 cases.

The sigmoid kidney (horseshoe kidney showing end to end fusion in a vertical manner on same side of body) occurred once.

Disc shaped fusion was not encountered.

## V. VARIATIONS IN PELVIS, URETER AND BLOOD VESSELS:

*Pelvis.*—An irregular, very large, pouched, single cavity occurred in two cases.

Division of a pelvis nearly always occurred in those cases showing multiple or branched ureters.

*Ureters.*—Multiple ureters for a short or long distance from the kidney occurred in a bilateral manner in three cases.

Multiple ureters, unilateral, appeared in seven cases—five times on the right and two times on the left side.

Complete doubling of the ureter from the kidney to a well defined pair of



apertures in the bladder was found in 8 cases (four times on each side; but in no case was it bilateral in occurrence).

One horseshoe kidney possessed three complete ureters.

A complete absence of a ureter was recorded twice.

Extreme congenital atrophy of a ureter was recorded 8 times.

In the case of sigmoid kidney, the dystopic left kidney possessed a ureter which began on the right side of the body, passed across the median line and assumed its normal course.

Short ureters were always associated with dystopic kidneys.

*Arteries.*—Variations in this system are said to occur in about 50% of all individuals;<sup>2</sup> but unfortunately, only spasmodic efforts were made in this series before removal of these organs and many variations of this order were no doubt overlooked.

Multiple renal arteries at a normal level were found in a bilateral manner 3 times.

Multiple arteries at a normal level, unilateral, were observed in 11 cases (7 on left and 4 on right side).

Bilateral origins of renal arteries at or near the bifurcation of the aorta occurred in 3 cases. A similar unilateral origin occurred 7 times.

A right renal artery took origin in two cases from a right common iliac artery.

An accessory left renal artery was found in two cases taking origin from the anterior wall of the aorta near the inferior mesenteric artery and running upward and to the left to divide and send a branch to the kidney and to the spleen.

Low origins between the normal level and the pelvic level occurred in 4 cases.

Both arteries came off the right side of aorta in the "sigmoid kidney" mentioned.

Congenital atrophy of the renal vessels occurred in those cases where the organs were extremely small.

Congenital absence was noted four times.

*Veins.*—Variations were not so commonly noted in these vessels as in the arteries.

Multiple veins at the normal level were not noted except for small accessory channels now and then leaving a pole to join either the regular renal vein or the cava.

Low entrance into the cava was common in cases of dystopic kidneys. Frequently, in such kidneys, venous channels were multiple; and some of them were very apt to enter an iliac vein instead of the cava. Absence of a renal vein was noted 3 times. Extreme atrophy occurred in four additional cases.

*Adrenal Glands.*—These structures were never absent, and usually showed no change other than slight modification in shape. They were usually in the general neighborhood of their normal position, no matter what type of a dystopic kidney was found nor whether there was congenital atrophy or absence of an organ.

## CLINICAL KNOWLEDGE OF VARIATIONS PRESENT

None of them were recognized as such, although two fused dystopic renal masses were palpated and caused the clinician to consider psoas abscess as the origin of the mass.

In another case of congenital absence of a kidney, the large kidney on the other side was badly injured by pyonephritis; and only the moribund state of the case when admitted prevented a nephrectomy being advised by the physician in charge.

## IMPORTANT ASSOCIATED DISEASES AMONG THE CASES OF RENAL ANOMALIES

Chronic diffuse nephritis in eight of the cases.

Congenital cystic kidneys, with a superimposed acute or chronic inflammatory process or severe hemorrhage into the cysts, in eight additional cases.

Pyonephritis in six cases.

Acute miliary tuberculosis in two cases.

## CAUSE OF DEATH IN THE 62 CASES OF ANOMALIES

The variations seldom played an important rôle. Deaths occurred, as a rule, from causes totally unrelated to the congenital defects. (See tabulation of the cases.)

## RECAPITULATION

1. A congenital absence of a kidney was found twice in the series of 4,215 consecutive cases. Piersol<sup>3</sup> states that this happens about once in every 2,650 individuals.

Extreme congenital atrophy of one kidney, almost to the point of its absence, was found in four more cases.

Marked congenital atrophy, a fibro-cystic mass of small size, was recorded in ten additional cases.

Extreme cases of congenital cystic kidneys forming large masses were found six times.

This forms a total of 22 cases; in which the change was limited to the right side in 8 cases, to the left side in 9 cases, and was bilateral in the others. Therefore, about 0.5% of the series were cases in which one side could not have been safely relied upon to assume the duties of the other in case of its incapacity from disease or injury; and nephrectomy would have been contra-indicated in this group of cases under any circumstances.

2. The "horseshoe kidney" occurred 7 times, or about once in 600 cases. Piersol<sup>4</sup> states that it is found about once in 1,000 cases. There is usually a marked malposition of the horseshoe or fused kidney to a position low in the abdomen over the psoas muscle groups or in the pelvis. This can lead to wrong conclusions, when found by palpation over these regions.

3. Congenital dystopia of a kidney, either in a unilateral or its bilateral fused state, occurred 15 times. A low position in the right iliac fossa or over the right sacro-iliac joint was observed in 6 cases; and in 6 more cases, in a corresponding position, on the left side. The location three times was over the median line in the lumbar region or over the promontory of the sacrum. Thus there was one case in every 281 individuals showing a low malposition of one or both organs. This can easily lead to confusion in palpation of the pelvic and low abdominal areas.

4. No accessory kidney was encountered. The number of kidneys was reduced to 1, by fusion in 7 individuals and by a congenital absence in two additional individuals.

5. Multiple ureters (unilateral or bilateral), going as far as the pelvic brim or sometimes as far as the bladder wall before fusion to empty as one normal channel, were found in 10 cases.

Complete doubling of the ureter was found in 8 cases.

Complete absence of a ureter was recorded in two cases; and extreme atrophy of a ureter in 8 more cases.

Short ureters were associated with all cases of renal dystopia. In all, there were 40 cases in the series which presented some form of a variation; but a multiple ureter which empties into the bladder as one channel is probably the variation which might cause the greatest difficulty in diagnosis, since ureteral catheterization without associated radiographic assistance might yield little knowledge of the functional state of such a kidney.

The pelvis of a kidney is frequently divided; and a given branch of the ureter would, therefore, drain only a fractional part of the kidney.

About 1 in every 100 cases had some form of a ureteral variation. Therefore, for good orientation in the study of these tracts, a combined ureteral catheterization, instillation and radiographic examination is indicated, if confusion is to be avoided.

6. Variations in number or origin of the renal arteries were noted in 40 cases but this by no means represents all that were present. They probably have little or no clinical importance, except to the surgeon during nephrectomy.

7. Veins: There were 25 variations found but these were practically associated with cases of renal dystopia.

8. Anomalies were slightly more frequent on the left side than the right side; while in about one-fifth of the series some form of a variation was bilateral.

9. Serious developmental defects were common enough in the renal apparatus to justify a careful examination of the entire system before directing radical surgical intervention against one side. Congenital cystic kidneys, usually bilateral, are probably the most serious variation, so far as danger to life is concerned, through the simple presence of the anomaly itself.

Some developmental defect in the system was found in 1.47% of the 4,215 consecutive cases. About one-third of these were capable of causing confusion in diagnosis and treatment.



10. Race did not appear to be an important factor in the incidence of the anomalies.

11. Sex: Nearly all the cases in the series examined were males; and, therefore, little can be said as to sex incidence. 53 cases were in males and 9 cases in females.

12. Age: Most of the individuals lived a normal length of time or died of a disease or accident that was totally unrelated to the presence of the anomaly.

13. There was never a consecutive series of more than 380 cases in which a renal variation of some character did not appear.

14. No sustained effort was made, in many parts of the series, to search for minor vascular and ureteral variations near the pelvis of the kidney nor for divisions in the pelvis.

Exaggerated kinking of the ureter was more or less frequently noted at the points where normal constrictions in the ureter are expected to occur.

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#### TABLE OF RENAL ANOMALIES

A-2057 to A-6271

1. *Autopsy 2057.*  
Colombia, 36 years, male.  
*Cause of death:* Lobar pneumonia.  
*Anomaly:* A horseshoe kidney at usual level for the kidneys. Its weight was 427 grammes. The isthmus connecting the two organs was quite as wide and thick as any part of the right or left side of the structure. The hilum of each side presented slightly upward and anteriorly. Ureters normal. Adrenals normal.
2. *Autopsy 2411.*  
Jamaica, 50 years, male.  
*Cause of death:* Duodenal ulcer. Suppurative cholangitis.  
*Anomaly:* Congenital fibro-cystic left kidney weighing but 54 grammes. Congenital atrophy of the ureter, artery and vein.
3. *Autopsy 2431.*  
Barbados, 26 years, male.  
*Cause of death:* Tuberculosis of the lungs.  
*Anomaly:* Congenital atrophy of the left kidney, weight 47 grammes while the right one weighed 150 grammes. The left kidney was almost globular in shape and not as large as a tennis ball. Its tissue and architecture were perfectly normal in appearance.
4. *Autopsy 2503.*  
Barbados, 24 years, male.  
*Cause of death:* Traumatism by steam shovel crushing.  
*Anomaly:* Horseshoe kidney. The right and left arms were connected by a narrow band of normal looking renal tissue. The renal mass was located almost entirely in the pelvis. Just a little of the upper pole of the right side of the mass was visible above the brim of the pelvis. The ureters were normal except that the right was only 13 cm. long and the left one 12 cm. in length. The renal arteries came off the aorta at the level of the bifurcation of the abdominal aorta. They

immediately divided so that each side of the renal mass received a branch anteriorly and posteriorly.

The veins were found at the same level.

Right adrenal attached to liver and the left one to the tail of the pancreas.

5. *Autopsy 2543.*

Barbados, 22 years, male.

*Cause of death:* Traumatism by railroad crushing.

*Anomaly:* Left kidney weight 65 grammes. It was located almost at the median line of the promontory of the sacrum. Its tissue was normal and its architecture regular. Its artery came off just above the bifurcation of the abdominal aorta. No note on veins. Adrenals were normal.

6. *Autopsy 2590.*

Barbados, 23 years, male.

*Cause of death:* Traumatism by railroad crushing.

*Anomaly:* Congenital atrophy of the right kidney; its weight was 4 grammes while the left one weighed 180 grammes. The right rudiment was a fibro-cystic, almond sized and shaped mass located on the surface of the diaphragm at the inferior surface of the right lobe of the liver. It had a patulous but extremely atrophic ureter. Its vessels were also extremely atrophic but the adrenal gland was normal in position and size.

7. *Autopsy 2721.*

Trinidad, 33 years, male.

*Cause of death:* Lobar pneumonia.

*Anomaly:* Congenital cystic atrophy of the left kidney. Its weight was 65 grammes while the right one weighed 145 grammes. A fibro-cystic mass without recognizable renal tissue. The upper half of the right kidney was also a fibro-cystic mass sharply defined from the lower part of the organ. The ureters were normal save that atrophy was noted in the left one. No notes on the vessels. Adrenals normal.

8. *Autopsy 3101.*

Spain, 33 years, male.

*Cause of death:* Estivo-autumnal malaria.

*Anomaly:* Congenital absence of the left kidney. No operative scar over the area. No left ureter and no aperture in the bladder on left side. There were no left renal vessels. The right kidney weighed 245 grammes. Normal architecture. The adrenal glands were normal.

9. *Autopsy 3146.*

Barbados, 20 years, male.

*Cause of death:* Disseminated tuberculosis.

*Anomaly:* Congenital cystic atrophy, extreme, of the left kidney. Its weight was 25 grammes. The right kidney weighed 295 grammes, and contained numerous miliary tubercles—otherwise its architecture was normal. Normal ureter and vessels on the right. There was no operative scar over the left renal area. A cystic body about 5 cm. in diameter and containing 24 c.c. of clear, yellow fluid with the odor of decomposed urine was found representing the rudiment of the left kidney; and it was located at the pelvic brim over the sacro-iliac joint. Two small cysts were attached at base of the large cyst and all cysts were attached to an almond shaped piece of fibrous tissue in a post peritoneal position. This solid piece of tissue measured 5 mm. x 5 mm. x 15 mm. A fibrous cord represented the left ureter but no visible aperture could be found in the bladder. Adrenals normal; left one attached to diaphragm. The fluid from the cysts was acid; contained abundant albumin, but no sugar. Sediment consisted of cellular debris; but no casts, pus or blood.

Unable to identify renal vessels on left side.

10. *Autopsy 3181.*

Martinique, 30 years, male.

*Cause of death:* Disseminated tuberculosis.

*Anomaly:* Discoid kidney, left. It was as round as a dollar, and quite flat, with a median cleft serving for a hilum. Artery, veins and ureter normal. Hilum presents slightly anteriorly. Weight of left kidney 120 grammes, right one 135 grammes. Each organ contained a few acute miliary tubercles.

Adrenals were normal.

11. *Autopsy 3240.*

Martinique, 39 years, male.

*Cause of death:* Cerebral hemorrhage, apoplexy.

*Anomaly:* Congenital atrophy of the right kidney. Its weight was 95 grammes while the left weighed 245 grammes. The right was situated about its normal length below its usual position. Its artery came off at a corresponding level. The upper half of this kidney was a cystic mass, sharply defined in a transverse manner from the tissue below. There was extreme congenital hypertrophy of the left kidney. Ureters normal, save that the right one was very small as compared to the left one.

Adrenals normal.

12. *Autopsy 3296.*

Jamaica, 12 years, male.

*Cause of death:* Suppurative nephritis in a solitary kidney.

*Anomaly:* Congenital absence of the right kidney. Congenital hypertrophy of the left kidney. This solitary left kidney was large enough for two normal organs. Its ureter was normal. There was a right ureteral aperture in the bladder; but it was much smaller than the left one. It was patulous; or at least traced up to the margin of the right psoas muscle, where it ended abruptly in a blunt closed end. No slightest trace of a renal rudiment found on the right side. The adrenals were normal. The disease in the left kidney was diagnosed and surgical intervention considered. The anomaly was not discovered during life.

13. *Autopsy 3364.*

Jamaica, 54 years, male.

*Cause of death:* Cancer (epithelioma) of the oesophagus.

*Anomaly:* Multiple ureters, bilateral and congenital atrophy of the right kidney. Left kidney had five ureters and the right one three to a point near the bladder where each emptied into the bladder through a normal ureteral aperture. Right kidney weighed 55 grammes and the left one 120 grammes. A fibro-cystic right kidney with a moderate amount of recognizable renal tissue was noted. Vessels normal on each side.

14. *Autopsy 3373.*

Nevis, 40 years, female.

*Cause of death:* Pellagra. Insanity.

*Anomaly:* Two arteries to each kidney and two large apple sized cysts (congenital ?) in left kidney, one in each pole. Two ureters for each kidney for a distance of several centimeters from the kidneys where they unite to form one and empty through normal apertures in the bladder.

A normal artery came off to each kidney and a second one came off to each organ on a level with the lower poles. Right kidney weighed 105 grammes, left one 120 grammes.

Adrenal glands normal.

15. *Autopsy 3382.*

Barbados, 21 years, male.

*Cause of death:* Chronic diffuse nephritis.

*Anomaly:* Two renal arteries to right kidney. They came off in a parallel manner from usual position in aorta.

16. *Autopsy 3383.*

Panama, 87 years, male.

*Cause of death:* Disseminated tuberculosis.

*Anomaly:* An accessory artery came off the anterior wall of the aorta just above the bifurcation and ran upward and to the left where it divided to send a branch to the lower pole of the spleen and another to lower pole of the left kidney.

17. *Autopsy 3395.*

St. Kitts, 30 years, male.

*Cause of death:* Lobar pneumonia.

*Anomaly:* Two complete ureters to right kidney. They were of normal size. One drained the upper third of the kidney while the other drained the lower two-thirds. They formed a long ureteral ridge in the bladder. The lower ureter had its aperture at the normal position, while the accessory structure had an aperture fully 2 cm. behind the normal location.

Right kidney weighed 155 grammes, and the left one 135 grammes.

18. *Autopsy 3408.*

Mexico, 54 years, male.

*Cause of death:* Lobar pneumonia.

*Anomaly:* Two complete ureters to the right kidney. Weight of right kidney was 220 grammes, the left one was 145 grammes. Each right ureter drained a half of the organ. The lower one seemed to occupy the normal position and has its aperture at a normal position in the bladder while the other aperture was above and posterior to normal position.

Adrenals, arteries and veins normal.

19. *Autopsy 3422.*

Barbados, 34 years, male.

*Cause of death:* Aneurysm.

*Anomaly:* Accessory artery to left kidney. This vessel took its origin from the anterior surface of the aorta near origin of inferior mesenteric artery. It ran upward and to the left to divide and send one branch to lower pole of kidney and the other to the spleen. Fetal lobulation of the kidneys was marked.

20. *Autopsy 3423.*

Barbados, 28 years, male.

*Cause of death:* Chronic nephritis.

*Anomaly:* Multiple ureters. The right kidney had 3 ureters at the hilum, two of which unite 3 cm. from the kidney and join the main channel near the pelvic brim to continue as one ureter. The left kidney had two ureters which united at the pelvic brim to continue as one channel.

Vessels and adrenals normal.

21. *Autopsy 3478.*

Jamaica, 43 years, male.

*Cause of death:* Rupture of a duodenal ulcer.

*Anomaly:* Flat discoid kidneys with a shape more like a spleen than a kidney. Each had a cleft on median surface which served as a hilum. Normal ureters and vessels. Adrenals normal. Combined weight of the kidneys, 245 grammes.



22. *Autopsy 3491.*  
Jamaica, 60 years, male.  
*Cause of death:* Chronic diffuse nephritis.  
*Anomaly:* Congenital cystic atrophy, extreme, of the right kidney. Its weight was 47 grammes while the left one weighed 117 grammes. Ureters and vessels normal.
23. *Autopsy 3630.*  
Panama, 11 months old, male. (West Indian negro parents).  
*Cause of death:* Acute colitis.  
*Anomaly:* Two complete ureters to right kidney. The pelvis of the kidney is divided and each ureter drains half the organ. The aperture for the upper ureter is situated above and behind the aperture in bladder of the lower ureter.  
Vessels normal. Adrenals normal.
24. *Autopsy 3856.*  
Ecuador, 12 years, male.  
*Cause of death:* Traumatism by automobile crushing.  
*Anomaly:* Horseshoe kidney, fusion of lower poles which forms an isthmus lying across the body of the second lumbar vertebra. The compound hilum presents somewhat upward and anteriorly. Ureters, vessels all normal. Weight of renal mass was 145 grammes.
25. *Autopsy 3951.*  
Barbados, 36 years, male.  
*Cause of death:* Tuberculosis of the lungs.  
*Anomaly:* Horseshoe kidney, fusion of lower two-thirds. The mass lies saddle fashion across right brim of pelvis at sacro-iliac joint. Its weight was 277 grammes. The upper or right half of this renal mass was over the psoas muscle and was palpated by the clinicians who believed it to be a "psoas abscess." A triple arterial supply was present. Two arteries came off the aorta above the bifurcation and a third came off simultaneously with the iliac arteries at the bifurcation. The veins emptied as one channel into the inferior cava. The compound pelvis presented anteriorly and toward the right. The right ureter was 16 cm. long and the left one 13 cm. in length. The renal mass pressure against iliac vessels seemed to have caused no inconvenience.
26. *Autopsy 4147.*  
New York, age 3 years and 9 months. Male. (White).  
*Cause of death:* Diphtheria.  
*Anomaly:* Extreme congenital cystic malformation of both kidneys. Combined weight of the organs was 145 grammes. Adrenals were normal.
27. *Autopsy 4196.*  
England, 44 years, male.  
*Cause of death:* Sarcoma of the lungs and pleura. Metastases.  
*Anomaly:* Two complete ureters to left kidney. These channels unite not far from the pelvis of the kidney to run as a double barrel in one sheath and empty through different apertures in the bladder. The pelvis of the left kidney is divided and each ureter drains a definite portion of the kidney.  
Right ureter normal. Vessels normal. Adrenals normal.  
Weight of left kidney, 298 grammes; right kidney, 157 grammes.
28. *Autopsy 4205.*  
West Indian negro, 5 months old, male.  
*Cause of death:* Acute entero-colitis.  
*Anomaly:* Congenital cystic right kidney. It forms a mass twice the size of the left kidney. It consists entirely of large closely packed cysts. Large bag-like pelvis but ureter is normal. Right kidney weighed 60 grammes, the left one 35 grammes.  
Adrenals and vessels normal.
29. *Autopsy 4308.*  
St. Lucia, 4 months, 11 days, male.  
*Cause of death:* Malnutrition. Congenital cystic kidney.  
*Anomaly:* Congenital cystic left kidney. It is twice the dimensions of the right one. Vessels, ureters, adrenals normal.
30. *Autopsy 4618.*  
Barbados, 24 years, female.  
*Cause of death:* Typhoid fever. Pyonephritis.  
*Anomaly:* Right kidney had a double ureter to pelvic brim. One branch was 10 cm. long and the other 6 cm. in length. Other structures normal.
31. *Autopsy 4648.*  
United States, white, 33 years, male.  
*Cause of death:* Fractured skull, contusion of brain from being hit over head with barrel of a rifle.  
*Anomaly:* Horse-shoe kidney. Fusion of lower poles by a broad, thick band of good renal tissue. Hilum presents somewhat anteriorly. Weight of the mass was 360 grammes. Each side had a normal ureter which crossed over the isthmus in its course toward the bladder. Position normal. Vessels and adrenals normal.

32. *Autopsy 4730.*  
Nevis, 24 years, male.  
*Cause of death:* Chronic nephritis. Cirrhosis of liver.  
*Anomaly:* Almost a complete congenital absence of the right kidney.  
The left kidney weighed 115 grammes and was the site of an extreme chronic diffuse nephritis. The right kidney weighed 5 grammes and was a small fibro-cystic lump of tissue buried in post-peritoneal fat at the usual position for the kidney. There was an atrophic ureter on the right side from the bladder to a point on a level with the pelvic brim where it ended in a blind sac. Right aperture in bladder extremely atrophic.  
No recognizable renal vessels on right side.  
The left vessels and ureter were normal.
33. *Autopsy 4734.*  
Jamaica, 64 years, male.  
*Cause of death:* Urethral strictures and acute suppurative disease of entire genito-urinary system.  
*Anomaly:* Two renal arteries to right kidney. Both came off aorta in parallel manner at usual site.
34. *Autopsy 4736.*  
Barbados, 36 years, male.  
*Cause of death:* Chronic nephritis. Mitral insufficiency.  
*Anomaly:* Three arteries to each kidney. The right received two vessels from the aorta at usual level but the upper one immediately divided at the wall of the aorta approaching the kidney as two well defined vessels.  
The left kidney received three separate arteries from the aorta, two of them coming off just below the usual site.
35. *Autopsy 4750.*  
Jamaica, 37 years, male.  
*Cause of death:* Rupture of aortic aneurysm into pericardium.  
*Anomaly:* Two arteries to left kidney. Extreme fetal lobulation of both kidneys. The right kidney was normal in size but the left one weighed 210 grammes. The two arteries came off aorta in parallel manner at usual site. One immediately divided.
36. *Autopsy 4755.*  
Barbados, 25 years, female.  
*Cause of death:* Epithelioma of cervix uteri, vagina, bladder, rectum.  
*Anomaly:* Two arteries to left kidney, came off aorta in a parallel manner at normal location.
37. *Autopsy 4758.*  
Barbados, 50 years, male.  
*Cause of death:* Tertiary syphilis, stricture urethra with extravasation of urine, gangrene of the lung.  
*Anomaly:* Two arteries to left kidney. They came off in a parallel manner at the usual site.
38. *Autopsy 4759.*  
Barbados, 56 years, male.  
*Cause of death:* Tertiary syphilis. Chronic aortic endocarditis.  
*Anomaly:* Right kidney weighed 145 grammes and the left one 100 grammes. Two arteries to right kidney at usual level from aorta.
39. *Autopsy 4920.*  
Barbados, 9 months, male.  
*Cause of death:* Infantile beriberi (Malnutrition).  
*Anomaly:* Variation in shape. Both kidneys were flat C shaped organs. The ureter of the left side was a large pouch becoming a ureter of normal character at level of lower pole of kidney. The renal arteries came off the aorta almost on a level with the lower poles of the kidneys. The veins took a similar peculiar exit.
40. *Autopsy 4926.*  
Jamaica, 30 years, male.  
*Cause of death:* Rupture of aortic aneurysm into peritoneum.  
*Anomaly:* Two complete arteries to left kidney. One was a normal vessel. The other took its origin about a centimeter below and ran upward behind the normal vessel to supply the upper third of the kidney. The left kidney weighed 200 grammes and the right one 150 grammes.
41. *Autopsy 4930.*  
Jamaica, 49 years, male.  
*Cause of death:* Stricture urethra and suppurative disease of entire genito-urinary system. Cholelithiasis, cholecystitis.  
*Anomaly:* Two arteries to left kidney. Came off parallel at normal site. Lower one supplied lower pole.
42. *Autopsy 4932.*  
Colombia, 49 years, female.  
*Cause of death:* Chronic diffuse nephritis.  
*Anomaly:* Three renal arteries to left kidney.
43. *Autopsy 4955.*  
Jamaica, 38 years, male.  
*Cause of death:* Cerebral hemorrhage, apoplexy.

- Anomaly:* Two arteries to left kidney. Congenital cystic kidneys. A cluster of cysts with a scant framework of fairly normal renal tissue composed each organ. The ureters were normal. The left kidney received two arteries—one the normal vessel while the second came off on a level with the upper pole which it entered. Left kidney weighed 245 grammes, while the right was 215 grammes.
44. *Autopsy 5079.*  
Jamaica, 18 months, female.  
*Cause of death:* Bronchopneumonia.  
*Anomaly:* Left kidney had two complete ureters with normal apertures in the bladder. Kidney weights: R—60 grammes, L—70 grammes.
45. *Autopsy 5256.*  
Spain, 26 years, male.  
*Cause of death:* Pneumococcus meningitis. Malignant endocarditis, Lobar pneumonia.  
*Anomaly:* Horseshoe kidney mass lying across vertebral column at the bifurcation of the aorta. The two arms were 5½ inches in length; the base or isthmus being 3 inches long. The general thickness of the mass was 2½ inches. Attached to the left arm was a smaller kidney mass 1½ inches in length. This small mass shaped somewhat like a little kidney appeared to be connected to the inner surface of the upper part of the left arm by connective tissue. From a mid point on the internal surface of the right arm sprang a well developed ureter which was attached to a more or less well formed pelvis. From the inferior surface of the small kidney mass and from a miniature pelvis sprang a second ureter. From the internal surface of the left arm beneath the small kidney mass and from an imperfect pelvis sprang a third ureter. The right ureter ran a normal course to a normal aperture. The left ureters were soon inclosed by the same peritoneal covering, but emptied into the bladder through separate apertures. On section of the mass the small kidney mass was found to be a continuation of the left arm mass. No notes on vessels or adrenals.
46. *Autopsy 5482.*  
Colombia, 44 years, male.  
*Cause of death:* General paralysis of the insane.  
*Anomaly:* Sigmoid kidney. Both kidneys on right side of the body. They were fused. The upper kidney, evidently the right, was in its normal position and its ureter ran a normal course to the aperture in the bladder. The kidney below, evidently the left one, received its artery directly from the right side of the abdominal aorta. Its ureter, however, crossed the median line and emptied into the bladder through a normal aperture at the usual position. The lower renal mass was only about one-third as large as the upper mass. The renal mass weighed 390 grammes.
47. *Autopsy 5591.*  
Jamaica, 29 years, female.  
*Cause of death:* Acute pyonephritis.  
*Anomaly:* Double left ureter to the bladder wall where they united to empty through one aperture. The pelvis of this kidney was divided and each ureter drained a given portion of the organ. Left kidney weight was 195 grammes. Right kidney weight was 150 grammes.
48. *Autopsy 5651.*  
Nevis, 10 months and 7 days, male.  
*Cause of death:* Congenital cyst of the brain.  
*Anomaly:* Congenital atrophy and malposition of left kidney. It was situated over the left antero-lateral surface of the 4th and 5th lumbar vertebrae; the lower pole being over left sacro-iliac joint. Its pelvis presented toward the anterior abdominal wall. The ureter was short but normal otherwise. The pelvic pouch concealed all vessels entering and leaving the kidney. The renal artery came off the left antero-lateral surface of the aorta at the bifurcation and immediately divided into two twigs both of which ran but a very short distance and entered the upper pole near the hilum. The renal vein occurred in a paired form. One crossed the upper end of the right common iliac artery and entered the cava, while the other ran externally and downward to enter the right iliac vein. Right kidney weighed 35 grammes, the left one 22 grammes. Adrenal glands were normal.
49. *Autopsy 5678.*  
Barbados, 1 year and 17 days, female.  
*Cause of death:* Infantile beriberi (Malnutrition).  
*Anomaly:* Congenital atrophy and malposition of right kidney. It was located almost at the brim of the pelvis. Ureter short but otherwise normal. Artery came off aorta at level of bifurcation of aorta. Right kidney weighed 15 grammes, left one 35 grammes. Adrenal glands normal. Hilum of right kidney presented anteriorly.
50. *Autopsy 5729.*  
Jamaica, 49 years, male.  
*Cause of death:* Disseminated tuberculosis.  
*Anomaly:* Malposition of left kidney and a triple ureter. The left kidney lies over the left sacro-iliac joint in the pelvis. The upper pole is barely visible above the brim of the true pelvis. Its artery comes off the anterior surface of the aorta simul-



taneously with the iliacs. It runs to the kidney where it divides and straddles the upper pole so that one branch enters each surface (anteriorly and posteriorly). There were two veins. One leaves posteriorly and runs upward to enter the left iliac vein, while the other leaves the antero-internal surface and runs upward to enter the cava.

The ureter was a three-fingered structure for about 1 inch and then formed one large ureter that entered the bladder after having passed behind the rectum. The right ureter was 16 inches long while the left was but 5 inches. The hilum of the left kidney presents anteriorly. There is slight congenital cystic formation to the left kidney. A few acute miliary tubercles were present.

The right kidney receives its artery at the upper pole where it divided and sent 3 branches downward along the face of the hilum. Its veins left the upper pole to enter cava at that level.

A few miliary tubercles were present.

Weight of right kidney was 185 grammes, the left 160 grammes.

Adrenals normal.

51. *Autopsy 5732.*

Panama, 3 days, male.

*Cause of death:* Haemophilia neonatorum.

*Anomaly:* Two complete ureters and apertures to left kidney.

Weights of kidneys: Right one 20 grammes and left one 25 grammes.

52. *Autopsy 5761.*

West Indian negro, 60 years, male.

*Cause of death:* Cerebral hemorrhage, apoplexy.

*Anomaly:* Malposition of right kidney. It was in the iliac fossa with the lower pole extending over brim of pelvis. Its pelvis presented anteriorly. There were two ureters which united to enter bladder as one channel. There were 3 arteries. One came off a little below normal position and ran down to upper pole. The next came off anterior wall aorta just above its bifurcation and entered the hilum. The third came off the right common iliac artery and entered lower pole of the kidney. There were 3 veins. They left the kidney where the arteries entered. Two entered the cava and one entered the iliac vein. Weights of kidneys: Right one 155 grammes, left one 105 grammes.

Adrenals normal.

53. *Autopsy 5768.*

Greece, 42 years, male.

*Cause of death:* Embolism and thrombosis.

*Anomaly:* Left kidney had two complete ureters and apertures.

54. *Autopsy 5815.*

Panama, 65 years, female.

*Cause of death:* Arteriosclerosis, senility, insanity.

*Anomaly:* Right kidney had two ureters for 5½ inches. They united to form one normal channel to the aperture in the bladder.

55. *Autopsy 5836.*

France, 62 years, male.

*Cause of death:* Cancer (epithelioma) of bladder and prostate.

*Anomaly:* Congenital cystic rudiment in position of right kidney. A fibro-cystic mass embedded in a large amount of post-peritoneal fat. Its weight was 65 grammes and it had normal vessels and ureter except for their extreme atrophy.

56. *Autopsy 5848.*

Jamaica, 55 years, male.

*Cause of death:* Congenital cystic kidneys with a superimposed acute and chronic nephritis.

*Anomaly:* Congenital cystic kidneys—Right, weight 75 grammes; left, weight 100 grammes. They were clusters of large and small cysts very closely packed. Ureters and vessels normal.

Adrenals normal.

57. *Autopsy 5938.*

Panama, 35 years, male.

*Cause of death:* General paralysis of the insane. Tuberculosis of the lungs.

*Anomaly:* Malposition of left kidney—located over left sacro-iliac joint. Pelvis presented anteriorly. The artery came off the anterior surface of the aorta a little above the bifurcation. Its vein entered the left iliac vein. Ureter quite short but otherwise normal. The left adrenal was attached to the tail of the pancreas. Although the left organ was misshaped and in an abnormal position it was as large as the right one.

58. *Autopsy 5971.*

Montserrat, 25 years, female.

*Cause of death:* Influenzal pneumonia.

*Anomaly:* The right kidney had two complete ureters and apertures. Weights of kidneys: R—160 grammes, L—120 grammes.

59. *Autopsy 6160.*

Jamaica, 42 years, male.

*Cause of death:* Acute perforative appendicitis. Peritonitis.

*Anomaly:* Malposition of left kidney. It was about a normal kidney length below its usual position. Its hilum faced anteriorly. Ureter was a little shorter but normal in other respects.

The artery came off a little lower and the vein emptied at a lower point but all vessels were normal otherwise.

Adrenal at tail of pancreas. Size of kidney nearly normal.

60. *Autopsy 6210.*

United States, white, 24 years, male.

*Cause of death:* Acute hemorrhagic pancreatitis.

*Anomaly:* Malposition of left kidney. It was found lying saddle fashion over the left pelvic brim at the sacro-iliac joint. Its ureter was short but normal otherwise. The artery came off just above the bifurcation of the aorta, divided and sent branches anteriorly and posteriorly over the upper pole of the kidney.

The veins (2) entered the iliac vein.

The pelvis presented anteriorly.

The adrenal gland was in its normal position, near tail of pancreas.

Weights of kidneys: Right 175 grammes, left 105 grammes.

61. *Autopsy 6266.*

Panama, 37 years, male.

*Cause of death:* Tertiary syphilis, cerebrospinal and cardiovascular. Blow on abdomen from falling mule and pommel of a saddle.

*Anomaly:* Flat discoid right kidney with triple ureters which unite to form one channel two inches from the kidney. The hilum faces anteriorly.

62. *Autopsy 6271.*

Barbados, 39 hours, female.

*Cause of death:* Cerebral laceration and hemorrhage, as a consequence of labor. Congenital malformations of skull and heart.

*Anomaly:* Right kidney had two ureters as far as the brim of the pelvis where they united to form one channel entering the bladder.

The right kidney had two arteries coming off side by side from the aorta at the usual position.

## PRELIMINARY REPORT ON THE BACTERIOLOGY OF THE WATERS OF THE COLOMBIA DIVISION

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While great hesitancy is felt in adding any further contributions to the large amount of work already published on water bacteriology, the following studies may prove of value to other tropical workers and are submitted to the tests of other investigators and to the proof of time.

Since the year 1928, the Hospital laboratory has been called upon to make numerous examinations of the drinking water supplied by various wells and open aqueducts in this Division. As determined by the standard methods, the percentage of *B. coli* was consistently high in all of them. Even where there was no apparent pollution of the soil or surrounding areas *B. coli*, as determined by the standard methods, was found in well waters. It was quite probable that the soil had been polluted during centuries of insanitary conditions; but it seemed reasonable to suppose that this pollution should have been counteracted by the brilliant sunlight and the dry heat. The fact that typhoid fever and bacillary dysentery had been reduced to a very low rate subsequent to the installation of driven wells with pumps in the locality, left some room for doubt as to whether the organisms obtained from well waters (which could not be differentiated from *B. coli* by the standard methods) were an accurate indication of fecal pollution.

Schobl and Ramirez, in Manila, while working on the same problem, made the following statement in their article on "The Fallacy of the Test for Lactose Fermenters as an Indicator of Faecal Pollution of Waters."

The fallacy of the test for lactose fermenters as an indication of faecal pollution is evident from the following conclusions:

1. Even though lactose fermenters other than true *B. coli* are frequently present in human and animal faeces, due to their wide distribution in nature and their presence in places where faecal contamination is excluded, these bacteria as a group can not be considered as an indication of faecal contamination.

2. On the other hand, we are justified in considering true *B. coli* as an indicator of faecal pollution, owing to its relatively limited distribution outside of the human and animal body.

3. True *B. coli* can be fairly readily differentiated from the other members of the coli group by the type of its colony on eosin-methylene-blue-lactose agar plate.

Hinman, in "Importance of Differentiating Colon Aerogenes Group in Examining Water," sums up the difficulties experienced in a routine laboratory which is called upon to do water analysis, when he says:

The method given in Standard Methods of Water Analysis for the differentiation of fecal from non-fecal members of the colon group is not practical for ordinary routine water laboratory purposes. The time required is prohibitive and before the indications could be obtained, the result would have only an historic value—requiring the sum of 18 days for the completed examination or 8 days if the gelatine is omitted. And when, at the cost of considerable effort, one is able to say that the organism is a fecal *Bacterium coli*, he finds that there is some doubt about the matter after all.

When one considers that, added to the difficulties enumerated above, workers in the tropics are confronted with the further problem of apparent gross contamination of the soil in all inhabited areas; the obstacles at first seem insurmountable, where time and apparatus are at a premium.

The method of Eijkman; which is based on the principle that only *B. coli* of warm-blooded animals will develop, producing acid and gas in glucose broth at 46°C.; was tried as a possible solution. By this method, practically all of the suspected organisms developed. This method has received wide acceptance in the hands of European workers; and the theoretical explanation for its failure to give satisfactory results in the tropics was that the soil bacteria have adapted themselves to temperatures at which the soil bacteria of temperate climates refuse to develop.

The method adopted by Pawan in Trinidad, who used the citrate media of Koser, seemed to offer a solution of the problem. When this method was tried, using Endo plates, and routine stool specimens as the source of the *B. coli*, 36% of all the organisms selected for culture showed growth in the citrate media as compared to 9.3% found by Stewart Koser in the United States and 3.7% found by Pawan in Trinidad. In this study, it was noticed that certain speci-



mens gave a ratio of 7.0% growth in citrate while others showed from 30% to 40%. Further observation revealed that the group which showed the low ratio of organisms growing in citrate was composed of first-class patients, while the high ratio group was composed of laborers from the banana zone who frequently drank irrigation canal water and whose food was prepared in the open and was subjected to contamination by dust and soil bacteria.

These findings seemed to indicate that the citrate and uric acid media were of real value in solving the problem.

The use of the eosin-methylene-blue-lactose plate of Levine was then instituted; and in the study of stool specimens it was found that only 7 (1.81%), out of 385 typical *B. coli* colonies studied, developed in citrate and uric acid media. Then 50 colonies, of the 385 mentioned, were examined by the Voges-Proskauer, indol and methyl red tests; and all of them, except one, gave the typical reactions of *B. coli*.

These preliminary studies, made during a period of two years, seemed to point toward a method of water examination which could be completed in a reasonable length of time as compared to the 15 to 18 days required by the standard methods and which was much more applicable to local conditions. The following method was then instituted:

1. Plate count, for total number of bacteria per c.c.; using increasing quantities of the sample of water, and plain agar as a medium.

2. Spread over the surface of a Levine eosin-methylene-blue-lactose plate 1 to 3 drops of the water under examination, and using a sufficient number of plates to obtain at least 100 well-isolated colonies.

3. Incubate at 37.5 degrees for 48 hours.

4. Make total count from plain agar plate. Examine the eosin-methylene-blue-lactose plate, counting 100 or 200 colonies and enumerating the number which show the typical gross morphology of *B. coli*. If, among these 200 colonies, there are some in which the typical morphology of *B. coli* is not definite; these are picked, and transferred to an agar slant. A Gram-stained preparation is made; and, if the morphology and staining characteristics are those of *B. coli*, they are transferred to citrate and uric acid media. If no growth result, these are included in the number of *B. coli* present. If growth results, they are classified as organisms other than *B. coli*.

This method is comparable to a white and differential blood-count—viz., the plain agar plate gives the total count; and the differentiation of the organisms is made with the eosin-methylene-blue-lactose plate, supplemented by the Gram stain and the citrate and uric acid media.

The following examples of the results of water examinations made by this method are given:

*Prado Water Supply, Santa Marta.*—The well is cased and covered; and the surroundings are in satisfactory sanitary condition.

Bacteria per c.c. . . . .	12
B. coli per c.c. . . . .	0

*Manzanares River, Santa Marta.*—The specimen was taken from a location opposite to the Hospital. The river serves as a laundry, bathing place, and sewer.

Bacteria per c.c. . . . .	4,000
B. coli per c.c. . . . .	324

*Quebrada Tamaca, at Jamonical.*—This specimen was obtained from a mountain stream which drains several coffee farms located along its course. It is subject to pollution, but has excellent natural purification.

Bacteria per c.c. . . . .	235
B. coli per c.c. . . . .	13

*Manzanares River, at Bonda.*—The conditions here are similar to those at Jamonical, except that the possible sources of pollution are farther removed.

Bacteria per c.c. . . . .	92
B. coli per c.c. . . . .	3

*Santa Ana.*—This specimen was taken from the well at the house of the Assistant Superintendent.

Bacteria per c.c. . . . .	19
B. coli per c.c. . . . .	0

*Aracataca.*—The sample of water was taken from an open aqueduct which supplies the American employees.

Bacteria per c.c. . . . .	600
B. coli per c.c. . . . .	6

*Sevilla.*—The well is cased and covered, and supplies water for the Superintendent's headquarters.

Bacteria per c.c. . . . .	32
B. coli per c.c. . . . .	0

*Latal.*—The sample was obtained from a driven well in the labor camp.

Bacteria per c.c. . . . .	13
B. coli per c.c. . . . .	0

CONCLUSIONS

1. The Standard Methods of Water Analysis do not give results which check with the actual findings determined by sanitary surveys of the water supplies in this Division.

2. The length of time required and the elaborate method involved in utilizing the Standard Methods make them unsuitable for routine clinical laboratories.
3. The eosin-methylene-blue-lactose plate method of Levine, supplemented by uric acid media and the citrate media of Koser, gives results which appear accurate after a study of 5,000 organisms.
4. The proposed method is simple.
5. Results are obtained which check with the sanitary surveys, and the health conditions and incidence of disease in the surrounding areas.

# CONDENSED SUMMARY OF THE LABORATORY WORK DONE IN THE SANTA MARTA HOSPITAL DURING 1929

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## PRELIMINARY REMARKS

A general summary of the character and scope of the work performed by the laboratory staff of the Santa Marta Hospital, and of the particularly interesting material which has been encountered during the year, is hereby submitted.

There were 1,019 more hospital admissions in 1929 than in 1928; and the number of laboratory determinations per patient has also been increased, due to a constant broadening of the activities of the laboratory. The laboratory examinations made for Clinic patients and in connection with field malaria surveys, are not included in Table 1.

TABLE 1

Year	Hospital Admissions	Laboratory Determinations	Determinations Per Patient
1928	3550	15,829	4.46
1929	4569	21,780	4.78

Blood examinations for malaria parasites have constituted the major portion of the routine work. Thick-film and thin-film preparations are made on each patient, although the latter are only stained when it is necessary. The incidence of malaria is shown by the data for the last 6 months of 1929 given in Table 2.

No fatalities occurred among uncomplicated cases of malaria.

The single case of blackwater fever which came under observation terminated fatally. On admission, at 5 p.m., there were no symptoms of the condition; and aestivo-autumnal crescents showed in the blood. About 10 p.m. the symptoms of blackwater fever were in evidence; and the following morning, no malarial parasites could be found in the blood. Blood examinations were made at fre-



quent intervals during the course of the illness, but no parasites were detected after the initial blood-film made on the day the patient entered the Hospital.

Malaria surveys of the labor camps were made at frequent intervals, and the routine procedure may be briefly outlined.

Blood specimens were taken by the sanitary inspectors and sent to the laboratory for diagnosis. The names of the patients whose blood was positive for malaria were sent to the respective sanitary inspectors, and treatment was administered by trained orderlies acting under the supervision of the inspectors. The results of treatment in the labor camps have been very unsatisfactory due to the constant migration of the laborers from one camp to another. A fair

TABLE 2

	July	Aug.	Sept.	Oct.	Nov.	Dec.
Admissions from Santa Marta (Town) . . . . .	125	148	105	143	129	128
Malaria Cases from Santa Marta . . . . .	0	1	1	3	0	4
Incidence of Malaria (per cent.). . . . .	0	0.67	0.95	2.09	0	3.12
Admissions from Farms . . . . .	278	234	266	326	307	261
Malaria Cases from Farms . . . . .	71	74	81	127	114	142
Incidence of Malaria (per cent.). . . . .	25.5	32.05	30.4	38.92	37.13	54.40
Total Hospital Admissions . . . . .	403	382	371	469	436	389
No. of Malaria Cases . . . . .	71	75	82	130	114	146
Incidence of Malaria (per cent.). . . . .	17.6	19.6	22.1	27.71	26.14	37.53

idea of the incidence of malaria infection among the laboring population is indicated by the fact that, of 4,228 persons examined in the camps, 867 (20.5%) were positive. The relative incidence of parasites was Aestivo-autumnal 587 (67.71%), Tertian 266 (30.68%), Quartan 7 (0.80%), and Mixed Infections 7 (0.80%).

A large portion of the work of the laboratory consists of urine examinations, and the only findings worthy of special comment are (a) the rarity of diabetic cases; (b) frequency of albuminuria; (c) frequency of red blood cells; and (d) the high incidence of *B. coli* infections.

Stool examinations of 2,306 specimens showed the incidence of parasites to be as follows:

TABLE 3

Uncinaria . . . . .	1,100
Trichuris . . . . .	663
Ascaris . . . . .	405
Oxyuris . . . . .	1
Strongyloides. . . . .	120
Taenia saginata. . . . .	1
"    solium . . . . .	0
Other tape worms. . . . .	10
Entamoeba histolytica. . . . .	943
Other entamoeba . . . . .	143
Balantidium coli . . . . .	13
Intestinal flagellates. . . . .	602

Sputum examinations were made on 574 specimens, of which 111 (19.5%) showed tubercle bacilli. The infection due to this organism is very prevalent in this locality, and the records probably do not begin to show the morbidity rate for this disease.

Culture work with tubercle bacilli was continued during the year, and a very interesting organism was isolated from the sputum of a patient who died with tuberculosis shortly after the cultures were made. This organism grows rapidly (3 to 8 days) on egg media, produces bright orange-colored colonies, is slightly more moist than the average tubercle bacillus, emulsifies readily in saline, is acid fast, is pathogenic for guinea pigs, and possesses a definite motility. Agglutination experiments with this organism and the serum of tubercular persons have been unsuccessful. This organism is worthy of much further study, which is impossible here due to the pressure of routine work.

*Bacillus leprae* is occasionally found. The greater part of the cases seen are sent to the Hospital for laboratory diagnosis by the local Department of Public Health and Hygiene. Numerous attempts have been made to grow *B. leprae*, but the methods recommended by various workers have invariably proved unsuccessful.

TABLE 4  
COMPLEMENT FIXATION AND PRECIPITIN TESTS FOR SYPHILIS

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Sera examined, 1,583. Wassermann Negative, 981. Wassermann Positive, 602 (38.02%)
Sera examined, 1,571. Kahn test negative, 904. Kahn test Positive, 667 (42.38%)

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A case of *B. enteritidis septicaemia* which terminated fatally was complicated by a severe *E. A. malaria* infection.

Diphtheria is rarely encountered, and only 2 cases were treated during the year.

Koch-Weeks' infections of the eye are prevalent; and, at the beginning of the windy season, the number of cases was greatly increased.

Cutaneous ulcers are responsible for a large number of sick days in the hospital and the laboratory findings have been very unsatisfactory. No *Leishmania tropica* were found in 67 ulcers examined, although it should be stated here that the ulcers had invariably been treated before the specimens were sent to the laboratory. The spirochaetes and fusiform bacilli of Vincent are a fairly constant finding; and a small gram-negative diplococcus, which resembles the gonococcus except that it is smaller in size, has been encountered in about 90% of the cases examined. Further culture experiments and vaccine therapy with this organism are contemplated.

*Gonococcus* infections are so common that laboratory examinations are seldom requested. The 60 positive smears, shown in the Consolidated Laboratory Report appearing on pages 428 to 431 of this report, are a record of only the treated cases or those in which the clinical evidence was slight.

In the figures appearing in Table 4 the anti-complementary Wassermann reactions are counted as negative. The Kahn test alone is used for emergency work, and the results are invariably checked with the Wassermann reactions made on the next day that serological tests are run. It is not intended to discard the Wassermann test in favor of the Kahn test, and the feeling of security which arises from utilizing two reliable tests and checking one against the other seems to more than justify the additional work involved.

The Wassermann technique employed in the Santa Marta Hospital is a modification of the test utilized by the New York State Board of Health Laboratories, and their antigens (Plain Alcoholic Extract and Cholesterinized Antigen) are used. The amboceptor in use in this Hospital was prepared here by immunizing a burro against sheep cells. Heat fixation is used for both antigens due to the lack of proper refrigeration facilities and because a highly sensitive Wassermann reaction is not desirable under local conditions.

Cerebrospinal fluid examinations have been limited to 32 specimens. Of these, 5 gave positive Wassermann reactions, with increased cell count, positive gold curve, increased globulin, and normal sugar values. From the limited number of examinations made, it would seem that syphilis of the central nervous system is very rare here in comparison with the incidence of infection as evidenced by the blood Wassermann tests.

Since the paper entitled "Wassermann, Kahn, and Meinicke (M.T.R.) Reactions in Caraate," appearing on Page 262 in the 1927 Annual Report, this laboratory has developed no additional data concerning positive Wassermann reactions in caraate cases. Attempts of Dr. H. M. Walker to produce caraate by using the fungus isolated by Dr. Howard Fox, were unsuccessful. Proof that the positive Wassermann reaction, which is found in a large percentage of these cases, is a non-specific fixation is still lacking.

Diseases of the enteric group have been very few in number. Six blood cultures were positive for *B. typhosus*, 1 for *B. paratyphosus* B, 1 for *B. enteritidis*, and 1 for *B. coli*. Only 16 positive Widal reactions were obtained during the year. Four cases of bacillary dysentery (1 of the Flexner group and 3 of the Hiss group) were found by stool culture. All dysenteric stools in which amoebae could not be found were cultured.

*Bacteriology.*—Apart from the routine blood, urine and stool cultures; the special studies with tubercle bacilli; and the attempts to grow *B. leprae*; the major part of our bacteriology consisted of water examinations, and the results will be given in a separate paper (See p. 285 of this report.) Numerous fungi have been isolated from the ear; and *B. pyocyaneus* has been isolated from that same source on three occasions. Numerous vaccines, both stock and autogenous, have been prepared.

*Live-Stock Examinations.*—Horses and mules have been examined for *Trypanosoma equinum*, upon the request of the Agricultural Department. Of fifty animals examined, only one was positive for this parasite. A guinea pig inocu-



lated from the positive animal lived for over 3 months, showing the parasites in large numbers in the blood stream during the whole course of the disease. The technical difficulties presented in connection with the examination of horses for this disease are very great, as the parasites may not appear in the peripheral blood more than 1 day a week, and it is practically impossible to spend a whole week away from the laboratory in order to examine horses. The field of animal pathology is practically untouched here, and work along this line would be exceedingly profitable from an economic, as well as from a scientific, standpoint.

*Rabies.*—The brains of 4 supposedly rabid dogs were examined for Negri bodies, with negative results; and it is believed that, if rabies were present in this region, some clinical cases would be seen as the number of stray dogs is very large. One of these cases was very interesting. In many respects, the clinical symptoms resembled rabies; but the findings of a staphylococcus meningitis at autopsy revealed the true nature of the disease.

*General Comments.*—During the past year very little original research work has been possible. There is a large amount of material available, and several very interesting problems might be investigated advantageously if there were sufficient time to devote to the study of it. Even among the mass of routine examinations which await us every day, there are a sufficient number of unusual findings and “beautiful” cases of malaria to make the work intensely interesting.

NOTE ON A TRYPANOSOME MORPHOLOGICALLY SIMILAR TO  
*TRYPANOSOMA CRUZI* CHAGAS, 1909, FOUND IN AN OPOSSUM,  
*DIDELPHIS MARSUPIALIS*, CAPTURED AT TELA, HONDURAS,  
CENTRAL AMERICA

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MATERIAL

On the 12th June, 1929 there was a sudden, sharp thunderstorm at the Puerto Arturo ranch in the neighbourhood of Tela, Honduras. As a result of the rapid rainfall, an opossum was forced to vacate a field drain in which it had taken refuge during the daylight hours. It was noticed by one of the workers on the ranch to be sluggish in its movements and behaving like a sick animal. He accordingly tried to catch it and succeeded in stunning it with the flat of his machete. Mr. MacIntosh, the veterinary surgeon at Puerto Arturo, to whom due acknowledgment must be made for providing the material and for his co-operation in the work, sent the opossum to the laboratory of the Tela Railroad Company's Hospital.



FIG. 1

FIG. 1. THE OPOSSUM, *Didelphis marsupialis*, CAPTURED AT THE PUERTO ARTURO RANCH, TELA, HONDURAS, CENTRAL AMERICA. THE LOWER PHOTOGRAPH SHOWS CLEARLY THE MARSUPIAL POUCH WITH THE HEAD OF ONE OF THE YOUNG PROJECTING

The animal proved to be a female with several young in her marsupial pouch. Obviously, from the general appearance, her condition was very bad; as she was thin and almost emaciated, with a scant covering of hair. Curiously enough there were very few ecto-parasitic insects; indeed only one tick was discovered on the animal and that, on microscopic examination, proved to be free from flagellates. After being some forty-eight hours in captivity the opossum escaped but was recaptured in an adjoining room two days later. It was then found to be harbouring trypanosomes and afterwards it remained infected right up to the time of its death on July 25th, 1929. Altogether the animal was under observation for forty four days.

#### POST MORTEM EXAMINATION OF THE OPOSSUM

The animal died during the night 24th–25th July. At the time the autopsy was performed it had been dead some hours and post mortem changes had begun.

*Abdomen.*—No increase of peritoneal fluid was noted and no signs of peritonitis except in one situation—on the upper aspect of the liver.

*Spleen.*—This organ appeared to be enlarged. It is difficult to be accurate on this point but, in relation to the size of the animal and in comparison with the same organ in another (presumably normal) opossum there seemed to be definite enlargement. The colour was light pink. On section the malpighian bodies were fairly well defined and the tissue was not friable.

*Kidneys.*—Just as in the case of the spleen the absence of a definite “normal” for purposes of comparison made the detection of abnormalities difficult. There was some slight congestion of both kidneys. There did not appear to be the usual marked differentiation between the cortical and medullar zones and the general impression was that of an organ in which cloudy swelling had taken place.

*Intestine.*—Beyond the presence of a large number of helminths in the small gut nothing was noted.

*Liver.*—The liver seemed to be a little enlarged but was not friable, while the lobular structure was quite well defined. There was a patch of peritonitis on the upper side resulting from an abscess in the thorax pointing through the diaphragm and then becoming localised.

*Thorax.*—As a result of the rupture of several abscess cavities in the lungs the pleural cavities contained much pus.

*Lungs.*—When the thorax was laid open the right lung was found to be occupying practically the whole of the anterior part of the cavity with the heart pushed up and backwards while the left lung occupied the remainder of the space posteriorly. The right lung was adherent to the diaphragm and in it were multiple abscesses the cavities of which were filled with a greenish coloured pus. One of these cavities had pointed through the diaphragm. Both lungs were extensively diseased, in fact it was almost impossible to find any normal lung tissue for such parts as were not involved in the abscesses, large or small, were practically solid. The pleurae were extensively involved.



*Heart*.—No gross lesions were noted. The muscle tissue tended to be pale and flabby looking. Both auricles and ventricles were filled with clot.

*Head*.—Portions of the large temporal muscle were preserved. On opening the skull the brain proved to be extremely soft—almost mushy—and, accordingly, was placed *en masse* in fixative.

#### MORPHOLOGY

When first detected in blood films the general appearance was similar to that of *T. cruzi* and this was fully borne out after further study. The movement and behaviour in fresh preparations corresponded closely. When fixed, the tendency, also exhibited by *T. cruzi*, to adopt a curved shape like the letter "C" was also distinctly present. The posterior extremity of the body was sharp pointed and "wedge" shaped and the parabasal body, like that of *T. cruzi*, was relatively very large, frequently projecting over the lateral boundaries of the body though this possibly was merely an accident in fixation.



FIG. 2. *Trypanosoma cruzi* CHAGAS, 1909. CAMERA LUCIDA DRAWING AT A MAGNIFICATION OF APPROX. 1,600. ADULT TRYPANOSOME FORMS FROM THE BLOOD OF THE OPOSSUM (Nos. 1-5) AND FROM GUINEA PIGS INOCULATED FROM CULTURE AND FROM THE DEJECTA OF INFECTED *Cimex rotundatus* (Nos. 6-11)

The outline of the parabasal body was most commonly rounded or ovoid but in some individuals it tended to be elongated in the transverse axis of the body. Rarely was it rod-shaped. The lateral flagellum passed down a fairly well developed undulating membrane but even so it did not have the wavy appearance associated with the same structure, say in *T. rhodesiense*. Anteriorly there was a distinct free end to the flagellum. The position of the nucleus is worthy of especial mention for, while central in the majority, there was nevertheless in some individuals a decided displacement to a position well anterior to the middle line even as far as the junction of the anterior and middle thirds of the body (Fig. 2—Nos. 1, 3, 7, 8 and 11). This anterior displacement, if such it can be called, was found more often during the early stages of the disease in the opossum and in subinoculated guinea pigs.

No dividing forms were ever encountered in the blood stream, and the differentiation of the trypanosomes into two types, as has been described in *T. cruzi*, the one shorter and stouter than the other, could not be made out clearly in the

present instance. The paucity of the forms in ordinary blood films was a handicap in deciding this point.

On the whole there was not a great variation in size. By far the majority had a body length of from  $18\mu$  to  $19\mu$ . The average length of the free portion of the flagellum was between  $7\mu$  and  $8\mu$  and the length over all from  $24\mu$  to  $28\mu$ . In many instances it was difficult to determine, when measuring the length of the free flagellum or the body length, just where the body ended as it gradually faded

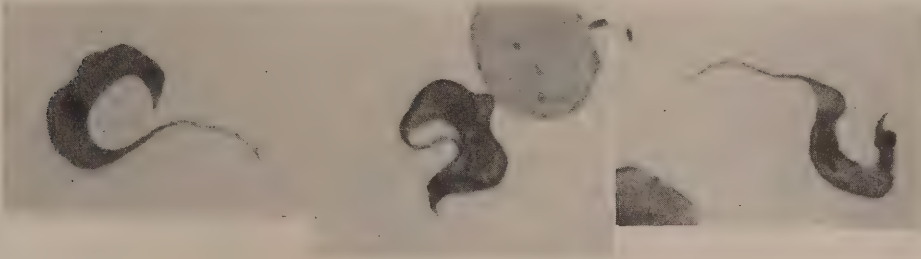


FIG. 3. *Trypanosoma cruzi* CHAGAS, 1909. PHOTOMICROGRAPHS AT A MAGNIFICATION OF APPROX. 2,100 DIAMETERS. ADULT TRYPANOSOME FORMS FROM THE PERIPHERAL BLOOD OF THE OPOSSUM

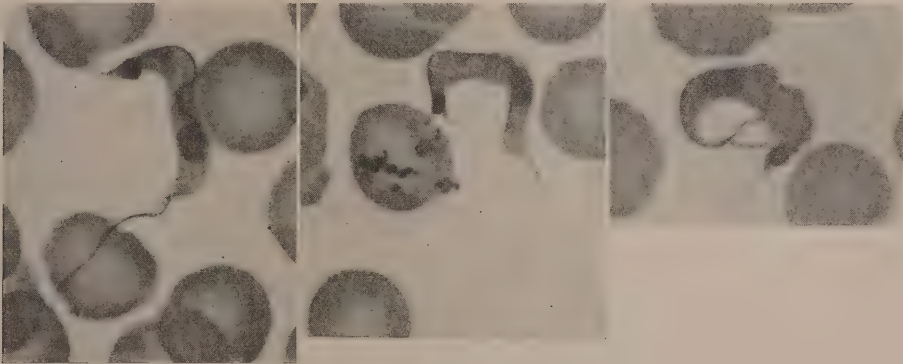


FIG. 4. *Trypanosoma cruzi* CHAGAS, 1909. PHOTOMICROGRAPHS AT A MAGNIFICATION OF APPROX. 2,100 DIAMETERS. ADULT TRYPANOSOME FORMS FROM THE BLOOD OF SUB-INOCULATED GUINEA PIGS

out, as it were, along the flagellum. Of course, as would naturally be expected, individuals were encountered, some shorter and some longer than the figures quoted, but in most of these the discrepancy could be accounted for by accidents in the making of the films.

From the foregoing it was obvious that this trypanosome bore an extraordinary resemblance to *T. cruzi*, at least as far as the forms occurring in the peripheral blood were concerned, and the experiments described hereafter were car-

ried out with a view to determining whether this resemblance in morphology and behaviour was maintained throughout all the other stages of the life cycle.

### CULTIVATION

The media employed in the first instance were as follows:

- (1) 2 per cent solution of agar agar in physiological saline. . . . . 1 cc.  
     Physiological saline. . . . . 8 cc.  
     Human blood. . . . . 1 cc.
- (2) The same as (1) except that nutrient agar was substituted for the ordinary agar.

Blood was obtained with aseptic precautions from the vein which runs along the side of the opossum's tail—this is sufficiently large to get into easily with a moderately sized hypodermic needle—and a small quantity was added to each of the culture tubes. No special measures, such as the addition of citrate, were taken to avoid clotting, lest the addition of such a salt would adversely affect the establishment of the organisms in the culture. The rapidity of the clotting, which in the case of the opossum seemed to be almost instantaneous, proved to be a source of annoyance.

The cultures were allowed to stand at room temperature, which, roughly, varied between 80° and 85°F. (26'7° and 29'4°C.), and in fourteen days were found to contain a luxuriant growth of flagellates. Motile and viable forms were still present in these original cultures four months after their inoculation. Temperature variations, if not too wide, do not seem to affect appreciably the rate of multiplication. Probably the optimum temperature is about 82°F. (28°C.).

Considerable difficulty was experienced, after the cultures were transported to England, in getting the organisms to establish themselves on the new medium. What this was due to is not easy to conjecture. It was not merely a matter of the pH of the medium for not infrequently one tube out of a batch of a dozen or so would contain a heavy growth while the remainder were all negative. Rabbit's blood, however, was used instead of human. A series of experiments were carried out with a view to determining what would be the best medium to use. Four kinds of media were prepared with precautions to see that the pH was the same in all instances. As controls the first and second were made the same as those already quoted under (1) and (2) above. The third and fourth were made up as follows:

- (3) 2 per cent. agar agar in physiological saline with the addition of  
     glucose (5 per cent). . . . . 1 cc.  
     Physiological saline. . . . . 8 cc.  
     Rabbit's blood. . . . . 1 cc.
- (4) 2 per cent nutrient agar in physiological saline with the addition  
     of glucose (5 per cent). . . . . 1 cc.  
     Physiological saline. . . . . 8 cc.  
     Rabbit's blood. . . . . 1 cc.



The introduction of glucose into the medium meant that sterilisation in the autoclave was no longer possible and in its place steam heat in a Koch's steam steriliser was used for one hour on three successive days.

The heaviest growth, after incubation at 82°F. (28°C.) for twelve days, was found in tubes of medium (4) on nutrient agar, blood and glucose. Next came the cultures on nutrient agar (2) and about equal in intensity but differing in certain other respects those on (3) ordinary agar plus glucose. The cultures on the ordinary blood agar were the poorest of all. From this a safe conclusion can be reached that the addition of glucose to the culture medium is a decided improvement, at least for the cultivation of the flagellate in the present instance. In addition to the multiplication at different rates in the various tubes another



FIG. 5. DIAGRAM SHOWING FOUR CULTURE TUBES INOCULATED WITH *T. cruzi*

The zone of heaviest growth is indicated by a heavier black line.

No. 1. On ordinary blood agar. (Medium No. 1).

No. 2. On blood agar plus glucose. (Medium No. 3).

No. 3. On nutrient blood agar. (Medium No. 2).

No. 4. On nutrient blood agar plus glucose. (Medium No. 4).

curious feature was observed, viz.: the maximum growth, which could be distinguished visually either as a slight mistiness or as a distinct massive white opacity, occurred at different levels. This has been indicated in the accompanying diagram. On the ordinary agar the point of maximum growth was at least one inch below the surface; on agar plus glucose about half that distance; on nutrient agar plus glucose a dense mass close to but still separated from the surface; and on nutrient agar alone closely applied to the surface. What may be the significance of this growth at different levels can be explained in many ways, such as the variations in the density of the culture medium; alterations in the surface tensions; differences in the chemical composition of the media and so on but it is at present impossible to make any definite statement.

## THE FORMS IN CULTURE

A great variety of forms are found in cultures of this organism. They approximate very closely to the cultural forms of *T. cruzi*; indeed it is quite impossible to distinguish one from the other solely on morphological grounds. There is a

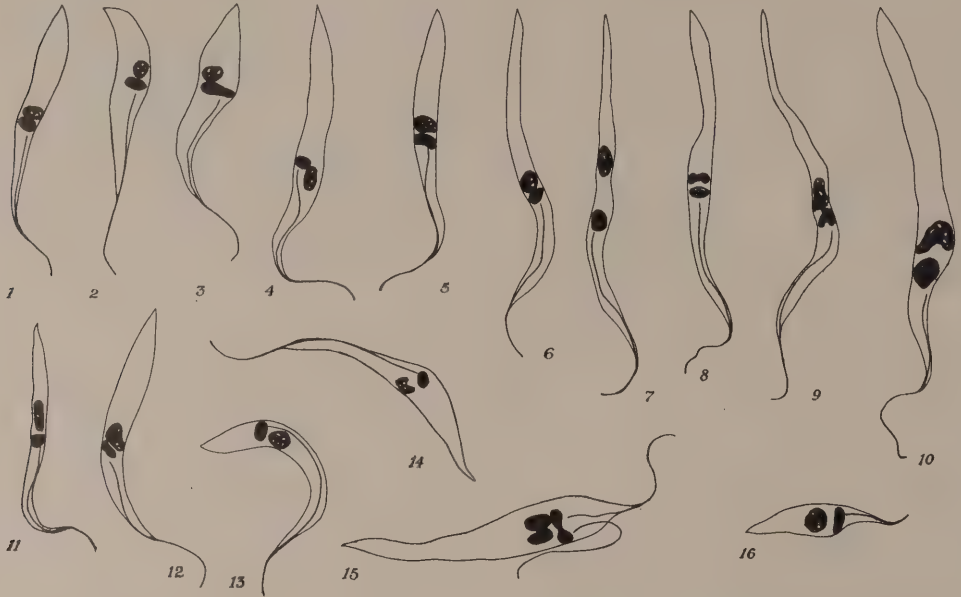


FIG. 6. *Trypanosoma cruzi* CHAGAS, 1909. FORMS FROM CULTURE DRAWN WITH THE CAMERA LUCIDA AT A MAGNIFICATION OF 1,600 DIAMETERS APPROX.

Nos. 1-3. Crithidia, shorter and stouter with the posterior end of the body rather wider.

Nos. 4-6. Crithidia. Transitional forms between the shorter varieties and the long ribbon-like forms. In No. 4 the para-basal body is just posterior to the nucleus; this is probably merely an accident in fixation.

Nos. 7-10. Crithidia. These are of the long ribbon-like type.

Nos. 11-12. Crithidia.

No. 13. Young trypanosome form with the parabasal body posterior to the nucleus.

No. 14. Young trypanosome in the transition stage from a crithidial form.

No. 15. Dividing crithidial form.

No. 16. Small crithidial form. This form seems to be the immediate descendant of the herpetomonad or leptomonad forms.

FIG. 7. *Trypanosoma cruzi* CHAGAS, 1909. PHOTOMICROGRAPHS AT A MAGNIFICATION OF APPROX. 2,100 DIAMETERS. VARIOUS STAGES FROM CULTURES OF THE ORGANISM ISOLATED FROM THE BLOOD OF THE OPOSSUM

No. 1. Crithidial form. The parabasal body is posterior to the nucleus; this is probably an accident in fixation.

No. 2. Crithidial form. Possibly the immediate precursor of the trypanosome form (No. 8).

No. 3. Crithidial form.

No. 4. Short stumpy crithidial form which has scarcely developed beyond the herpetomonad or leptomonad stage. It is in process of division.

No. 5. Thin but short crithidia.

No. 6. Leptomonad or herpetomonad form in process of division.

No. 7. Crithidial form.

No. 8. Trypanosome form. This stage is comparatively rare in culture.

No. 9. Short crithidial form.

No. 10. Longer and broader crithidial form.

No. 11. Crithidial form in process of active division. There are three nuclei.

No. 12. Short stumpy crithidial form derived from leptomonad or herpetomonad form.



FIG. 7



close resemblance between these cultural forms and the types found in the reduviid infected with the present strain or even with *T. cruzi*. The preponderating type is a crithidia about  $27\mu$  in total length of which the flagellum occupies some  $7\mu$  and the body  $20\mu$  or  $21\mu$  (Fig. 6, Nos. 1 to 4). Long ribbon-like forms (Fig. 6, Nos. 7 to 10) are quite common and such individuals may measure (including the flagellum) as many as  $42\mu$  or  $45\mu$  or even longer. Somewhat less frequently shorter and stumpier crithidia (Fig. 6, No. 16) are encountered and very rarely indeed an occasional leptomonad form. Organisms are sometimes met with rounded up, and it is possible that these may represent a leishmania-like stage in the development; but, on the other hand it is equally probable that

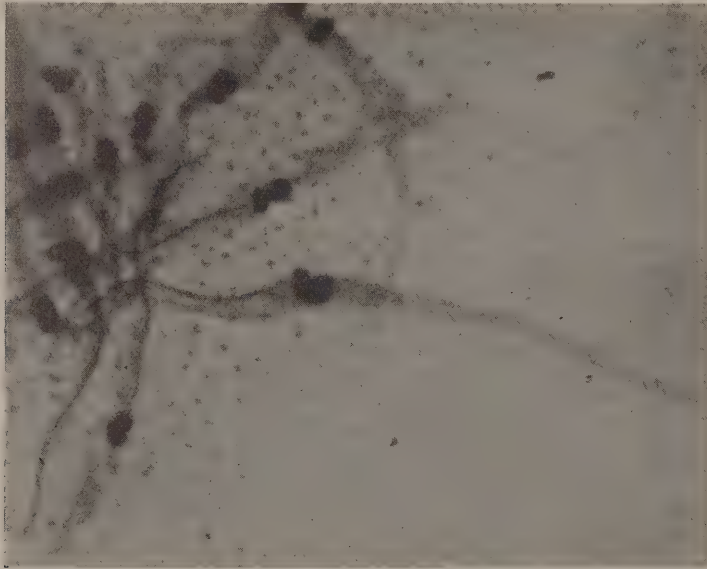


FIG. 8. PHOTOMICROGRAPH AT A MAGNIFICATION OF APPROX. 2,100 DIAMETERS. MARGIN OF A ROSETTE FROM CULTURE SHOWING ONE OF THE LONG, NARROW, RIBBON-LIKE FORMS

they may merely be degenerate forms accidentally bereft of flagella. At the other extreme (in the developmental sense) may be placed the trypanosome forms, which are only found after a prolonged search. The appearance of these trypanosomes is suggestive of the metacyclic forms found in the rectum of the bug or perhaps it might more appropriately be said that they look like forms which would eventually develop into metacyclic forms. That such forms are the precursors of the metacyclic trypanosomes is highly probable, for infection can certainly be produced in an experimental guinea pig by inoculation of culture. This would suggest that either these are metacyclic forms, or have the power of development into that stage after inoculation. It does not seem at all probable that they represent the adult trypanosome stage of the blood stream. Trypanosome forms seem to be of more frequent occurrence in the early stages of each

culture. That is to say they appear in the first few days after inoculation and then are lost when the prevailing type is the crithidia described above. Further, these trypanosome forms were more numerous in the original culture than in the subsequent sub-cultures.

The actual cycle of development in culture is very difficult to follow for there are so many divergent forms multiplying at the same time and, accordingly, a definite statement cannot be made on this subject at present.

With regard to the morphology there is one point which should be noted with regard to the cultural forms. The parabasal body, not in the trypanosome forms but in the crithidia and other varieties, is not oval or rounded but is rod shaped. The ends of the rod are rounded and the rod itself may be bent, giving a bean or kidney outline; but usually there is the impression of a bar or rod of chromatinic material.

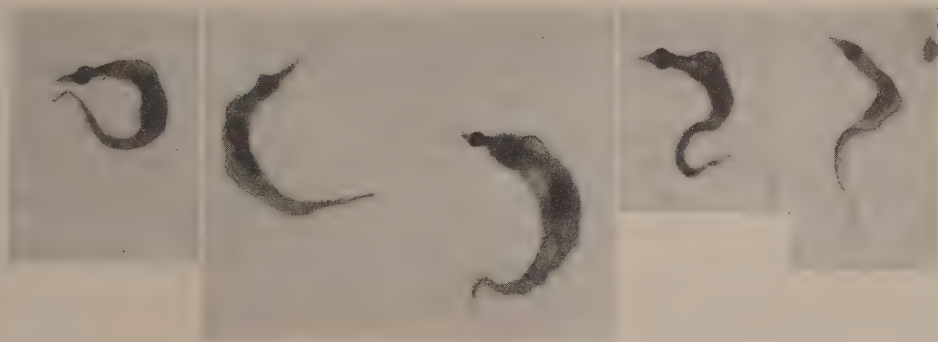


FIG. 9. PHOTOMICROGRAPHS AT A MAGNIFICATION OF APPROX. 2,100 DIAMETERS. METACYCLIC TRYPANOSOME FORMS FROM THE DEJECTA (MALPIGHIAN SECRETION?) OF THE BUG *Cimex rotundatus* EXPERIMENTALLY INFECTED FROM THE OPOSSUM

#### TRANSMISSION EXPERIMENTS

Two guinea pigs were inoculated with blood from the opossum. The first died within seven days without showing trypanosomes in its blood but the second did develop an infection from which apparently it recovered. The second guinea pig was inoculated on 1st July and the first appearance of the trypanosomes took place on the 14th of that month. The infection was transient lasting for about two to two and a half weeks only. The numbers in the peripheral blood gradually increased and then diminished. The disappearance, however, was much more rapid. From this guinea pig, while the infection was at its height, two other guinea pigs were inoculated. One of these died at sea during transit from Honduras to England and the other on arrival was found to have no organisms in its blood nor has it subsequently shown any signs of infection. On the other hand the animal which died at sea had definite fever and every sign of disease, and, as the time corresponded with the period of infection in the first successfully inoculated guinea pig, it is possible that death was due to the trypanosomiasis. Although at the time microscopical examination was not possible the tissues were preserved for further study and will be reported on later.

Arguing by analogy that, since *T. cruzi* is known to undergo a cyclical development in reduviids, some insect of the same species might act as the vector in Honduras of the present strain, an attempt was made to infect the local "chinche" or *Cimex rotundatus*. The only reason why this species was used was because of the ease with which successive supplies could be obtained. From the original batch of adults a laboratory generation was hatched out known to be non-infected and these were fed on the opossum. The bugs were allowed to feed on several occasions so that there would be every chance of obtaining infected individuals out of each batch. Three months later, after transportation to England, these bugs were found to be infected. After feeding, the insect usually passes a drop of clear fluid—malpighian secretion (?)—and in this, metacyclic forms were present. A guinea pig was inoculated with some of this infected fluid and 32 days later was found to be infected with typical *T. cruzi* in the peripheral blood. At the time of writing this experimental animal is still showing trypanosomes, but the numbers have decreased somewhat from the maximum. The infection has persisted so far for 17 days. Dissection of the *Cimex* has shown the presence in the alimentary tract of the various developmental forms. As these have been mentioned already in connexion with the cultures a detailed description is not necessary here.

At the time that the guinea pig was inoculated with the dejecta of the bed bug another young guinea pig was injected with a massive dose of the culture in which a few metacyclic or what may be termed "premetacyclic" trypanosomes were present along with large numbers of crithidia. This guinea pig also showed the infection 32 days later.

#### FORMS IN THE OPOSSUM'S TISSUES

A detailed description of the histopathological changes in the tissues of the opossum cannot be given as yet; indeed it is felt that, since the animal died from some disease other than the trypanosomiasis, or, since the trypanosomiasis was, perhaps, only a contributory factor to the death, the alterations in the tissues would not present a typical picture such as would be given by trypanosomiasis *per se*. Developmental forms at various stages were found in the heart muscle. These were present in the oval or elongated spaces in the muscle fibres just as would be found with *T. cruzi*. Compared with an infection of *T. cruzi* in an experimental rat the number of spaces containing organisms were rather scanty but there were, however, many clear spaces in the muscle fibres, into which small haemorrhages had often taken place or areas where there had been destruction of the fibres, highly suggestive of lesions from which the organisms might have made their escape. The parasites were in the form of crithidia and "young" trypanosomes.



RESERVOIR HOSTS OF *T. cruzi*

The finding of *Trypanosoma cruzi* as a natural infection in the opossum opens up the question as to what animals may be infected with this (or some closely allied) trypanosome. Trypanosomes have been described in South American Monkeys by Leger, M., and Porry, E. (1918) but the descriptions of their two species scarcely tallied with that of *T. cruzi*. On the other hand Terry, B. T. (1911) gave an account of certain organisms from the blood of 28 out of 130 monkeys at the laboratories of the Rockefeller Institute for Medical Research, New York City. In the *Macacus rhesus* the forms found were very similar to the adult forms of *T. cruzi* in the peripheral blood. None of his animals had a heavy infection nor did the trypanosomes appear to be possessed of a high degree of pathogenicity. Terry stated in his description that "the micronucleus is usually at the extreme posterior end of the parasite, is strikingly large, measures  $1\mu$  or more in diameter, and often projects on either side of the parasite. The nucleus is oval . . . . and is situated near the juncture of the anterior  $\frac{1}{3}$  and the posterior  $\frac{2}{3}$  of the body. The entire length of the parasites thus far measured has varied between  $25\mu$  and  $28\mu$ ." For this organism Terry proposed the name *Trypanosoma rhesii*. Although no definite deductions can be made from Terry's statement nevertheless it is highly suggestive and future research might eventually prove that these forms were part of the life cycle of a parasite similar to *T. cruzi*.

Other mentions have been made of trypanosomes in the blood of animals such as those of Watson (1912) in the cotton tail bush rabbit (*Trypanosoma leporis-sylvaticus*) and of Hadwen (1912) who found *Trypanosoma soricis* in the blood of the wandering shrew, *Sorex vagrans*. In the same category may be placed the *Trypanozoon otospermophili* Wellman and Wherry (1910) from the Californian ground squirrel. From the description this organism seems to have many features in common with *T. lewisi* but differs in that the parabasal body depicted was definitely rounded and attempts to inoculate young white rats were unsuccessful. In these instances the descriptions are insufficient to determine the exact nature of the organism.

Mention must be made of *Endotrypanum schaudinni* Mesnil and Brimont, 1908 encountered in the blood of Hoffman's sloth in French Guiana. From the descriptions (Mesnil and Brimont, 1908 and Darling, 1914) it is quite clear that this parasite living as it does in the blood cells and not as a rule free in the plasma is specifically distinct from *T. cruzi*.

Lastly, in this connexion, the trypanosome of the bat endemic in Italy, in Alsace and other parts of Europe bears an extraordinary resemblance to *T. cruzi*. The first discovery was probably that of Dionisi but it was left to Bataglia, 1905 to name it *Trypanosoma vespertilionis*. Pringault (1914) demonstrated a form of transmission by *Cimex pipistrelli* and in 1921 Chatton and Courrier amplified the description of the life cycle in the bat *Vesperugo pipistrellus* showing that it was

quite analogous to the developmental cycle of *T. cruzi*. On account of the close similarity they named their organism *Schizotrypanum pipistrelli*.

With regard to the known reservoir hosts of *T. cruzi* the armadillo has so far been considered to be by far the most important. This animal was incriminated in the first place through Chagas (1912) finding developmental forms of a trypanosome similar to those of *T. cruzi* in the alimentary tract of the reduviid *Triatoma geniculata* which infests the burrows of the armadillo *Dasypus novemcinctus*. In the armadillos themselves a trypanosome was found morphologically identical with *T. cruzi*. Experimentally it was possible to inoculate the organisms both from the bug and from the armadillo into guinea pigs.

Further work on these lines was done by Torres (1915) and by Chagas (1918). The former incriminated three species of armadillos, *D. novemcinctus*, *D. unicinctus* and *D. sexcinctus* as natural hosts while the latter found as many as 46 to 50 per cent of *D. novemcinctus* infected. Chagas has also reported natural infections in a cat (1909) and in monkeys (*Chrysothrix sciureus*) from the Para district of Brazil.

#### GEOGRAPHICAL DISTRIBUTION OF *T. cruzi*

*T. cruzi* in man was first demonstrated by Chagas in children at Minas in Brazil and since then has been shown to occur in other parts of Brazil. Tejera (1919) described cases of the disease in Venezuela and Escomel (1919) also found infections in Peru.

It is not within the scope of the present paper to enter into a discussion concerning the vectors of *Trypanosoma cruzi* but it is significant that various reduviids have been found to harbour flagellates similar to the forms of *T. cruzi* in geographical areas far removed from what has been so far recognised as the endemic focus of Chagas's disease. Maggio and Rosenbusch (1915), for example, found it in *Triatoma infestans* in the Argentine, while Neiva (1914) described infections in *T. vitticeps* from the State of Rio and also referred to the work of Hurtado in San Salvador who found a trypanosome-like organism in a *Triatoma* ? species.

In 1920, Tejera, E. proposed the name *Trypanosoma rangeli* for flagellates which he found in the alimentary tract of the reduviid *Rhodnius prolixus*. Tejera's drawings and descriptions leave little doubt but that he was dealing with what is now recognised as the life cycle of *T. cruzi* in the bug. Kofoed, C. A., and McCulloch, I. (1916) found a flagellate which they called *Trypanosoma triatomae* in the alimentary tract of a hemipteran bug *Triatoma protracta* Uhler. The bug infests the nests of the wood rat *Neotoma fuscipes*. The stages described and figured by these two authors are in the majority of respects quite analogous to the corresponding developmental or cultural forms of *T. cruzi*; it is unfortunate that they did not carry their researches further and attempt to isolate a trypanosome from the wood rat itself. Their bestowal of a new specific name on this flagellate is curious in view of their statement that "we know too little of the life

history in both this form and of *Schizotrypanum cruzi* to stress the apparent differences between the two."

The *Crithidia conorhinae* which Donovan (1909) found in *Triatoma rubrofasciata* in India, and the *Trypanosoma boylei* of Lafont (1912) discovered in the gut of the same insect in Mauritius may be the intervening stages in the life cycle of a trypanosome.

#### DISCUSSION

From the foregoing observations there does not seem any reasonable ground for supposing that the organism isolated from the blood of the opossum is specifically distinct from *T. cruzi* Chagas, 1909. Such slight morphological variations as may be present, e.g., the adoption by the nucleus in some of the blood forms of a station rather more anterior than usual, may quite well be accounted for by its occurrence in the present host, the opossum, or by "racial" distinctions. It has been shown (Thomson and Robertson, 1926) that in the case of the African trypanosomes, *T. gambiense* and *T. rhodesiense*, that a considerable degree of morphological variation may result from the passage of the "race" or strain through hosts of different species. In the same way there may be wide divergences in the virulence of the organisms following similar passages from host to host of different species. *T. cruzi* certainly exhibits this latter feature of varying virulence (Wenyon, 1926). A strain of *T. cruzi* which the writer has maintained in the laboratory (in England) for the past nine years, is possessed of only slight virulence. Guinea pigs have never been successfully inoculated and the only animals which show a really heavy infection are young rats but even then the inoculation must take place at a very early age, say at a week or ten days. The opossum strain, on the other hand, will infect both adult and young guinea pigs, but the infection appears to be of a transient nature with recovery after a varying length of time. *T. cruzi* produces a much heavier infection in young animals than it does in adults. This statement is probably true in the case of man; the disease was first noted in children.

This leads on to another series of deductions. First taking into account the finding of infected reduviids by Hurtado in Salvador, next the isolation of the present strain in Honduras and the fact that the local bed bug of Honduras (*Cimex rotundatus*) is capable of transmitting the disease, it is reasonable to conclude that these are not solitary examples but that the disease is much wider spread geographically than has hitherto been suspected. Again, as has been pointed out, the virulence varies with the species of the host and of the age of the individual within that species.

It is therefore quite within the bounds of possibility or even probability that cases of trypanosomiasis due to *T. cruzi* may occur in man in Honduras and this may serve as an explanation for the occurrence of some of those obscure conditions found especially in young children. Clinically cases are met with in children or infants where there is a severe degree of anaemia accompanied by a curious



puffiness of the face and for which no ostensible cause can be assigned. The failure to demonstrate by microscopical technique the presence of the organisms in blood films, either of the thin or even the thick variety, cannot be considered as proof that infection is non-existent. Supposing, as is more than likely, that the degree of pathogenicity, comparatively speaking, is of low degree, then the numbers of trypanosomes in the peripheral blood will be scanty, so much so indeed that reliance can be placed only on methods of culture or the infection of a clean, laboratory strain of reduviids as a sure means of diagnosis. The inoculation of animals, owing to the possibility of their having a natural infection or to the danger of lighting up again a previously dormant condition from the injection of foreign proteid, is a measure of doubtful value, and, further, since *T. cruzi* shows such wide variations in the virulence of divergent strains, the infection of any given species of laboratory animal is far from certain, or if an infection should be produced the numbers in the blood might be so small as to defy detection.

There is an additional point, which subsequent work alone can clear up, as to how far the disease has been disseminated over the American continent, and in view of the present work, especially over the northern part. While temperature and humidity will play a rôle in determining this distribution, it seems quite likely that neither will prove of the same importance as they are, to quote an extreme example, in the case of malaria. Cultures of *T. cruzi* will flourish at room temperature in England and the writer has kept *Cimex lectularius* infected in the laboratory for nine months in that country. Again the fact that the opossum may act as a reservoir host is highly suggestive for the genus *Didelphis* enjoys a wide geographical distribution. The intensity of the infection in the specimen captured at Tela might be accounted for by the concurrent infection of the lungs lowering the bodily resistance as a whole but this does not alter the fact that the animal is subject to natural infection with this parasite.

#### SUMMARY

1. *T. cruzi* Chagas, 1909 was isolated from the blood of an opossum, *Didelphis marsupialis* captured at Tela, Honduras.
2. The trypanosome forms in the blood were morphologically similar to *T. cruzi* except that in some the nucleus was rather nearer the anterior or flagellar end of the body.
3. The developmental stages of the parasite were found in the heart muscle of the opossum.
4. *Cimex rotundatus*, the local bed bug or "chinche" of Honduras was successfully infected by feeding on the opossum. The *Cimex* were still infected three months later.
5. A guinea pig was successfully inoculated with blood from the opossum. The blood forms were identical with those from the opossum. The infection in the guinea pig was transient lasting from two to two and a half weeks.
6. A guinea pig was inoculated with the infected dejecta of the *Cimex* and

developed an infection in the peripheral blood one month from the date of inoculation.

7. The organism was isolated in culture (on Wenyon's modification of Noguchi's blood agar medium) and the forms in culture corresponded closely to those in culture of a known strain of *T. cruzi*.

8. An experimental guinea pig showed trypanosomes in its blood one month after inoculation with the cultural forms. The infection also proved to be a transient one lasting for 21 days.

9. Tela, Honduras is some 2,000 miles distant from what has hitherto been regarded as the endemic zone of this form of trypanosomiasis.

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## SANITATION IN THE TROPICS

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For a number of years, the United Fruit Company has waged an energetic campaign of sanitation; and, as a brief review of the problems confronting the sanitarian in a tropical locality and the manner in which some of them have been dealt with may be of service to sanitarians in general, a short summary of some of the measures adopted is submitted herewith:



## WATER

*Advantages Derived From Proper Water Supply.*—A pure and uncontaminated water supply, adequate for drinking, culinary, laundering and bathing purposes, is absolutely essential for proper sanitation. The United Fruit Company endeavors to furnish such a supply to all the towns, villages and camps located on its plantations, and to maintain them properly at all times. Thoughtless people often say that the people in labor camps are dirty, but when given water facilities for bathing and the washing of clothes, the laborers will keep as clean as the local conditions will permit. The laborers are quick to appreciate the availability of this necessity of life; and a sanitary inspector is immediately informed by them if the supply fails. A camp with good drinking water, and adjacent to a clear stream where the people can wash their clothes and bathe, can always keep the best class of employees; and, furthermore, a camp so situated will show a relatively low rate of morbidity and disability as compared with a camp not possessing such an advantage.

*Possible Sources of Water Supply.*—Towns and the larger settlements are usually supplied by pipe lines running from central distributing plants which are under constant supervision; but many labor camps and isolated habitations must rely on local sources of supply. The latter may be rainwater collected in tanks, barrels, or other receptacles; bored or pipe-driven wells; or running streams; and the advantages and disadvantages of each must be considered from two standpoints—(a) possibility of contamination, and (b) facility with which mosquito-breeding can be controlled.

*Rainwater as a Source of Supply.*—In some localities it is necessary to rely upon rainwater collected in containers, or to bring water from a distance and keep it in barrels. Under such conditions it is necessary to exercise constant vigilance to prevent the breeding of mosquitoes. If the containers are not mosquito-proof, or properly treated with oil, they serve as ideal breeding places for culex mosquitoes. Furthermore, the waste water or overflow from such containers frequently forms small puddles where Anopheles mosquitoes breed. If barrels are kept in the dwellings, or on the verandas, the waste water will cause the floor to rot. The best methods for overcoming these undesirable features of tanks or barrels in places where the use of them can not be discontinued will be discussed later under the heading of "Elimination or Control of Man-made Mosquito Breeding Places."

*Bored or Pipe-driven Wells as Sources of Water Supply.*—In several Divisions underground sources of water have been tapped by bored or pipe-driven wells. In most instances these have furnished adequate supplies of cool, potable water, and a simple pump arrangement makes it readily accessible. Wells of this character are inexpensive and ideal from a malaria-control standpoint, as provision must be made only to take care of the waste water. It is essential, however, that every possible precaution be taken to avoid contamination of such sources of water supply, and the character of the soil must be taken into consideration in determining the minimum distance at which latrines or other sewage can be located.

*Running Streams and Ponds as Source of Water Supply.*—These furnish an abundant supply of potable water, providing they are properly protected against contamination. However, from the standpoint of malaria control, they may prove to be a serious menace to nearby population, as the shallow edges are generally covered by vegetation and form ideal breeding places for *Anopheles* mosquitoes. Such streams and ponds are sometimes stocked with larva-eating fish, as this is an economical method of control, although it is not entirely effective unless the vegetable growth along the banks is removed periodically. This method of control has proved to be very successful in some of our Divisions and it has only been necessary to cut the vegetation below water level at monthly intervals. The cost is low and the fish accomplish the work that the local inspectors ordinarily would have to do with larvicidal agents. Furthermore, if Paris green or petroleum preparations were used, the results would be unsatisfactory unless the vegetation along the banks was removed, as such growth affords protection to the larvae and makes them inaccessible to the fish or the larvicidal preparation. It may be mentioned here, however, that proper selection of camp sites should always be given careful consideration, with the object of locating them as far as practicable from uncontrollable water surfaces and still provide them with an ample supply of good water to meet the requirements of the occupants.

#### ELIMINATION OR CONTROL OF MAN-MADE MOSQUITO BREEDING PLACES

It has frequently been mentioned in publications issued by the Medical Department of the United Fruit Company that the larger proportion of the mosquito-breeding foci in the vicinity of habitations are man-made in character and can be readily eliminated if the employees would render the proper degree of cooperation. The *possible sources of water supply* have been previously mentioned; but, regardless of the source or the method in which it is made available for the use of the employees and their families, certain protection must be taken to prevent the formation of mosquito-breeding water surfaces. The most prevalent types of unnecessary and avoidable breeding places and the methods by which they can be most advantageously and economically eliminated may be briefly outlined:

*Improper Location and Grading of Camps.*—A camp should be located as far as possible from any large body of water where control of mosquito-breeding is difficult or impossible. If practicable, the site of the camp should be of “turtle-back” formation, with the crown under the central barrack in the middle row; so that the ground will slope gradually to the front, and rear. Under such conditions, no drains will be necessary if the ground is porous; and only a small drain in the front and in the rear will be required to carry off surface water if the soil is not porous. Since this method of arranging camps has been adopted, many potential breeding places which formerly existed in the vicinity of laborers’ quarters have been eliminated. In the past, it was customary, when construct-

ing a camp, to dig many drains—e.g., in the front, in the rear, around individual barracones and kitchens, lateral drains through the camps, etc. These drains, with the continual cleaning from time to time, became deeper and deeper; until, eventually, they had no outlets and required constant larviciding. Large piles of earth were thrown out when cleaning the drains, and these accumulated alongside and prevented the surface water from entering the drains—hence, numerous puddles and pools were formed, which made ideal breeding places for *Anopheles* mosquitoes. It is well known that the best way to permanently eradicate mosquito breeding is to eliminate accumulations of water; and, therefore, all unnecessary drains should be filled and the number of “necessary” drains reduced to the minimum.

*Unnecessary Water Faucets and Outlets.*—The overflow from faucets and the drains of pumps and water-tanks will accumulate and make puddles which are favorite breeding-places for the *Anopheles* mosquitoes. It is essential that the number of faucets be restricted to the actual requirements of a community; and that the waste water from the necessary outlets be promptly disposed of or treated. The methods utilized for dealing with this problem will be discussed later.

*Miscellaneous Man-Made Mosquito-Breeding Foci.*—In addition to the avoidable breeding places previously mentioned, empty containers, hoofprints, crab-holes, and similar places where small bodies of water may collect are fertile fields for the production of mosquitoes. Grass should be cut periodically in the vicinity of habitations so that small pools of water, empty cans, etc., may be readily seen and the condition remedied. Corrals, which are usually situated near residences, should be paved or constructed in such a manner that they will not become mud-holes where mosquitoes can breed; and, moreover, muddy corrals will frequently cause hoof-rot in the animals confined therein.

#### CONTROL OF MOSQUITO-BREEDING WATER SURFACES

The more common types of potential mosquito-breeding water surfaces have already been mentioned specifically. When it is impossible, impracticable, or uneconomical to eradicate them, one of several means of control must be adopted. Reference has already been made to the feasibility of stocking with larvae-eating fish, large areas of water which cannot be economically drained or filled. The breeding of mosquitoes in such bodies of water, as well as in smaller collections of water, may also be prevented by the use of Paris green, or some petroleum product; and the procedures which have proved most effective and expedient in the Company's plantations will be briefly detailed later.

In some localities collections of waste water from faucets, tanks, wash-houses, etc., have been eliminated by adapting the sub-surface drainage principle to local conditions. For example, a hole about 14 inches in diameter is bored down to sand or gravel stratum. The hole is then lined with old cement cans and filled with rock. Satisfactory results have also been obtained by digging a hole about



4 feet in diameter and 2 feet deep, and filling it with large rocks. A drain, leading from this hole toward the main camp-drain, is also filled with rocks (placing the large stones at the bottom and smaller ones above); and the hole and the drain are then covered with earth. The water flows off, and is absorbed under ground in the same manner as though subsoil tiles were used. Either of these measures eliminates unsightly open drains, and reduces the cost of maintenance.

Proper attention to the location of faucets, overflow pipes, and similar sources of waste water, will materially lessen the difficulties of malaria-control work. Whenever possible, faucets should be placed directly over the drain situated at the front and rear of a camp, thereby avoiding the necessity of lateral drains or other provisions for handling the waste water.

In many instances in the past, when little or no attention was devoted to such matters, a water tank might have a faucet in the front and one in the rear; and overflow pipes might be found on either side. This resulted in numerous drains being required, or wet areas on all sides. These conditions have been changed, and overflow outlets are placed directly above the faucet so that only one drain is necessary. Furthermore, it is recommended that this drain be constructed in the manner outlined in the preceding paragraph, or that the faucet be removed from the tank and placed at the end of a pipe line leading from the tank to the main drain in the front or the rear of the camp. Washing and laundering will then be done alongside of the main drain, and the ground around the tank will remain dry. Where there is a sewer pipe or a cement wash basin adjacent to a water tank, of course, it is advisable to have the overflow pipe connected directly to it.

Around kitchens and wash-houses where slops are thrown; a deep hole about 1 foot in diameter and filled with rock, where the water falls, will eliminate the mud-hole which otherwise may exist.

In some of the more recently constructed camps a very fine type of community wash-house has been installed, which does away with individual wash-houses. This policy has resulted in a great improvement in the sanitary appearance of the camps.

#### CONTROL OF WATER SURFACES BY PETROLEUM OR ARSENICAL PREPARATIONS

Extensive bodies of water which are adaptable for the breeding of mosquitoes; if it is impracticable to drain or fill them, or to stock them with fish; must be controlled by applications of oil or Paris green.

*Petroleum Preparations As Larvicidal Agents.*—Slow running drains or streams, or impounded waters, can be advantageously treated with oil, which will kill all species of mosquitoes if properly applied. Heavy oil, which has been utilized frequently, is ineffectual. Most of it is wasted, as it stays in globules and does not spread over the entire surface of the water; and in consequence the larvae can breathe in the air spaces which remain. A mixture of heavy and light oil is much

more efficacious; and 3 parts of fuel oil to 1 part of Diesel oil, is recommended. The consistency of the oil used ranges between 28° and 32° Baume. After the oil is sprinkled over the water, it is brushed in to the sides of the banks and broken up on the surface of the water by using a large burlap bag attached by a wire loop to a pole in such a manner as to permit the bag to swing back and forth freely. This process impregnates the sides of the ditch with the oil and thereby deters mosquitoes from laying their eggs in the edges of the water; and also kills all types of mosquito larvae with which it comes in contact. Where this system is used in ditches and drains, breeding has been almost completely prevented.

In many places good results are obtained by the use of an automatic oil drip. A container is sunk under the water. A valve or petcock, which can be regulated so as to permit a definite number of drops of oil per minute to escape, is placed on the top of the container; and the oil is forced through the valve by water which enters the receptacle through a tube in the bottom of it.

By utilizing a standard consistency of oil and drilling the outlet on the container the exact size required to suit the oil, it has been found practicable to dispense with the valve—and the drops come out at the desired rate per minute and spread in a thin film over the surface of the water.

Use has also been made of the exhausts from gasoline electric plants, by placing an oil drip over the drain where the exhaust pipe discharges. The hot water and steam strikes around the outlet on the drip; and the oil is heated, and thereby thinned so that when it comes into contact with the water it spreads out in a thin film. Where sawdust is plentiful; oil soaked in sawdust is sometimes used, as it saves oil and is efficacious on small ponds and swamps. These unusual measures are mentioned merely with the object of illustrating the advisability; and, in some instances, the necessity of a sanitarian adapting himself to local conditions in order to obtain the maximum results with the minimum expenditure.

*Paris Green As A Larvicidal Agent.*—Paris green is very effective under certain conditions. Large drains or ditches running through or near camps; creeks, swamps and river edges, containing considerable vegetation and not flowing too rapidly; pools, hoofprints, crab-holes, drains around camps—all such water surfaces may be advantageously treated with Paris green.

There are many commercial preparations of Paris green on the market; but only a few contain an effective percentage of arsenic and an appropriate size of crystals so that they may be readily ingested by the larvae, and care must be exercised in selecting the product.

It is usually mixed with a diluent, in the proportion 1:100, and a machine is used for the purpose. In various localities different diluents are utilized, depending upon the availability of the agent selected; and in some instances two or more ingredients are mixed together, but the ratio of 1 part of Paris green to 100 parts of diluent is maintained. Road dust, ashes, lime and sawdust have all been used with more or less success. Where sawdust is the only agent obtainable, it has worked well when passed through an 18-mesh screen before being mixed with

the Paris green. Lime, when used as a diluent, has one advantage—it is readily discernible on the surface of the water and enables the sanitary inspector to determine at a glance whether or not an area has been properly treated.

It has been our experience that the Paris green mixture can be applied most advantageously and expeditiously by hand. A very fine dust is needed for use in the mechanical duster; and, when there is much wind, as is often the case, the dust is carried up into the air and blown away as it comes out at the end of the nozzle.

#### LATRINES

There is no problem in camp sanitation that has been more difficult of solution than the selection of a satisfactory latrine for outlying districts where it is impracticable to install flush toilets. An essential feature of a satisfactory latrine is that it should be so constructed that cleanliness may be maintained with a minimum of attention and care. The ordinary laborer in any locality will exercise little effort to keep it clean; and an insanitary latrine will be foul and malodorous, and attract flies which convey certain forms of disease-producing bacteria.

The bored-hole latrine, as developed in the Dutch East Indies and the Indian Empire, appears to solve the problem and are being gradually installed in the Company's rural districts. A hole 12 to 14 inches in diameter is bored by an auger to a depth of 18 to 20 feet, or to at least 4 feet below the permanent water level. In the East this is lined with a woven bamboo tube, which prevents caving; but other materials may be used, such as concrete, corrugated iron, etc. Wood does not make an entirely satisfactory lining, as it readily decays. The opening on the surface of the ground is covered by a concrete slab about 3 feet square in which an elongated opening, 4 to 5 inches in width and 9 to 10 inches in length is made. The slab should be so constructed that all rain water falling on it runs into the opening, the under edges of which are bevelled back; as the water is required in the hole as a medium for digestion, and the rain descending on the concrete slab will help to maintain cleanliness. These latrines are of the "squatting type" and their efficiency is destroyed if a regular seat is installed. A wooden plug, with an upright handle 2 feet long, is made to fit the opening which should be kept closed when not in use. In the squatting position the defecations are directed straight downward, and do not foul the sides. They are odorless; fly and mosquito proof; of economical construction; and perfectly satisfactory and sanitary. They can be installed in the back yard, without offense to the most sensitive. They do not require a roofed building, but a hedge will furnish the necessary privacy.

#### WHITE-WASHING

Many of the camps have been whitewashed, with very beneficial results. A white wall is far more attractive than the dark, dirty walls, and has a tendency to induce laborers to take a greater interest in their general surroundings. Fur-



thermore, whitewashed rooms are not attractive resting-places for mosquitoes during daylight hours; and those which do remain in the dwelling can be readily detected and killed. The cost is small; and, particularly, if a spray pump is used.

#### SCREENING—SPRAYING—MOSQUITO NETS

When it is practicable, and when the occupants are sufficiently intelligent, prudent and careful to appreciate the benefits derived therefrom; screening of dwellings is the ideal method of protection.

In instances where screening is impracticable or impossible, laborers are encouraged to use mosquito-nets. However, an improperly screened house (e.g., too large mesh of wire), or a defective mosquito-net (e.g., containing holes or other means of ingress for mosquitoes) is worse than an unscreened residence or no net. It is not uncommon, during inspection, to find 5 or 10 *Anopheles* mosquitoes inside a mosquito-net in which a man had slept the previous night; and as many as 75 have been killed in a single net.

A sanitary inspector should make every possible effort to enlist the help of laborers, and experience has shown that their coöperation may be obtained by exercising a little patience. The members of the sanitary squad should explain the manner in which malaria is contracted; show the people the species of mosquito which transmits the infection and the method of identifying it while it is at rest; encourage them to seek for the insects within their nets and their dwellings; and demonstrate the best measures of adjusting mosquito-nets, killing mosquitoes found in the residence, etc. In some localities admirable results have been obtained by inspectors who have devoted some attention to such educational work; and many laborers purchase spray pumps and insecticidal agents which are sold at cost by the commissaries. Commercial preparations are used in some places, while in others home-made preparations—the base of which is kerosene, mixed with pyrethrum extract, carbon tetrachloride, or one of the commercial products—are utilized effectively and economically.

#### GARBAGE

Adequate provision must be made for the disposal of garbage and rubbish. Garbage should be burned, if possible; but, if this cannot be done, garbage pits should be located some distance from habitations and covered with earth as soon as they are filled—otherwise, in tropical locations where there is heavy rainfall, they become mosquito-breeding foci and are a menace to the health of the community. Metal barrels, in which cement and other products are shipped to the tropics, make good practical garbage cans; and are frequently available in large quantities.

Manure should be disposed of in such a manner as to prevent fly-breeding near human dwellings. Where it is utilized for fertilizing purposes, it should be treated before it is removed; and about 1 pound of borax to 12 bushels of manure will effect the desired results.

## GENERAL DUTIES OF A SANITARY INSPECTOR

The duties of a sanitary inspector are multitudinous. In addition to the various problems previously enumerated and detailed, he should exercise careful supervision over all other conditions affecting the health and comfort of the community. Hotels, mess halls, cantinas, commissaries, labor barracones and other living quarters, slaughter-houses, dairies, stables, etc., should be inspected regularly; and defective screening, leaky faucets and tanks, and water containers which are not mosquito-proof, should be promptly attended to or reported to the proper authorities for their immediate attention. The sanitary inspector and his squad should spray all parts of a residence which might harbor mosquitoes, including the mosquito-nets, until such progress is made that he can rely upon the occupants to do so. Special attention should be given to all places where food is produced or sold; as a dirty slaughter-house, insanitary dairy, carelessly handled food in a commissary or mess hall, and similar conditions are a constant menace to the health of the people.

The maximum results in sanitation can only be obtained by the voluntary coöperation of every resident; and to enlist such coöperation should be the ultimate aim of the sanitary inspector. If he will approach the laborers in a cheerful and considerate manner, manifest a real interest in their health and welfare, minister to the sick to the best of his ability, and in other ways show that he is working in their behalf; he will soon gain their confidence and respect and receive their coöperation.

Proper camp sanitation can only be maintained when the overseer inspects his camps daily. He must not merely ride through it or past it, but must carefully inspect the drains, living quarters, and kitchen, and seek the sick. As soon as he and the sanitary inspector possess the confidence of the people, they will keep a cleaner and more sanitary camp, with less effort and expense. Where it is impossible to get satisfactory results otherwise, it may be necessary to appoint a camp boy to see that the grounds are kept in proper condition; and the reduced morbidity and increased efficiency will more than justify the expenditure.

Some sanitary inspectors have adopted the practice of carrying with them a supply of quinine, plasmochin, and salts. If he finds a laborer suffering with fever, he gives him a sufficient quantity of the drugs for a course of treatment; and this will frequently enable the man to recover without loss of time from his work, and prevent hospitalization.

## GENERAL COMMENTS

In this article the writer has endeavored to give a brief review of the salient features of sanitation in a tropical locality. Malaria has been responsible for a large proportion of the morbidity in the American tropics; and, as Sir Ronald Ross said "No stagnant water, no mosquitoes; and, no mosquitoes, no malaria." A properly built camp should have no standing water within its bounds or immedi-

ately adjacent to it. Small depressions with water in them may breed thousands of *Anopheles* mosquitoes. It is therefore much more economical to sanitize a camp when it is under construction, and thus prevent mosquito-breeding and labor loss from malaria; than to attempt to control breeding in a camp which has been improperly located and badly constructed. A camp site, well chosen and correctly graded, will be free of innumerable drains which hold water and often garbage and other refuse; and, instead of cutting the grass in a tedious and labor-consuming manner with a machete, a horse-drawn or motor-driven mower can do the work much better and cheaper. Level grounds, with short grass, are comparatively easy to keep clean; and the cost of upkeep and maintenance is cut in half. Today, with tractors, harrows, scrapers, road machines, dredges, and similar modern machinery available in most localities, it is possible to prepare labor-camp sites in a proper and satisfactory manner, without involving a large expenditure. Furthermore, in such camps the overseers are stimulated to plant fruit and shade trees, shrubs and flowers. A beautiful, dry, level, green expanse around the laborers quarters (similar to those already existing on some of our plantations) will make living conditions more sanitary and attractive; and such an environment will result in making more contented laborers and reducing labor turnover.

Only persistent and conscientious effort on the part of everybody, from the highest to the lowest employee, will produce the best results; and every possible medium should be utilized to educate all the people of the community in regard to malaria-control, hygiene, and sanitation in general. Wherever there are schools, the curriculum should include these subjects; pamphlets should be distributed periodically to all literate inhabitants; moving pictures should be exhibited—in other words, advantage should be taken of all available means to disseminate knowledge of this character.

In conclusion, it may be stated that the results attained to date are extremely gratifying and justify the belief that the time may soon come when malaria will cease to be endemic in the plantations of the Company.

## STEAMSHIP SANITATION

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In Boston, New York and New Orleans, the United Fruit Company maintains staffs of employees who have been trained thoroughly in fumigation and sanitation and who devote their entire working hours to inspecting, improving and correcting sanitary conditions aboard the ships while in port.



Immediately after the arrival of the ship, this staff proceeds on board and inspects it for insanitary conditions. Their principal duties involve the proper disposal of garbage; elimination of foul odors; location of evidences of insect and rodent infestations; checking rat wiring; and determining whether or not the food supplies and water used for culinary and drinking purposes are free of contamination and the containers are in a state of cleanliness. The methods which have been found by experience to be most practicable and efficacious are herewith briefly detailed:

During each voyage, while at sea, the Master, Chief Steward, and Doctor aboard passenger vessels, are required by Company regulations to conduct a conjoint daily inspection of the ship for the purpose of ascertaining sanitary conditions aboard the ship. A composite report based on their findings from time to time is rendered to the Port Medical Office on a specific form, immediately after the steamer arrives at the home port. This form is prepared in the nature of a questionnaire; and is so worded as to include specific information concerning the character and exact locations of any insanitary conditions reported by passengers, officers and crew members, as well as the names of the persons furnishing the information or registering the complaint.

Thorough maintenance of sanitation on a steamship entails much time and effort, and is best accomplished by obtaining the full coöperation of the Ship's officers—particularly of the Chief Steward, as, during the time that the ship is away from the home port, he is expected to maintain it in a state of cleanliness and to direct the use of insecticides, germicides, deodorants, etc., (which are supplied to his Department on each voyage) as circumstances may necessitate.

If a doctor is employed on board a steamship, it is his duty to see that these measures are carried out properly and to bring to the attention of the Master any indifference or laxity on the part of those delegated to perform such work.

Numerous experiments have been conducted, in an endeavor to ascertain the most efficient measures for the eradication of rodents and insects; and, at the present time, the preparations and methods outlined below are considered most reliable and efficacious.

All sections of the steamship are periodically fumigated by the liberation of cyanide (HCN) gas; which destroys all rodents and insect life. However, the eggs of the latter are not affected nor rendered sterile. In consequence, during the period elapsing between fumigations, it is necessary to utilize other means for destroying insects; and the most effective agent developed thus far is a powder prepared in accordance with the United Fruit Company's formula:

Sodium Fluoride . . . . .	4 lbs.
Powdered Licorice. . . . .	8 ozs.
Powdered Borax . . . . .	1 lb.
Pyrethrum. . . . .	4 lbs.
Corn Starch . . . . .	2 lbs.

This insecticide has been given the commercial name of "Doomsect."

After a room has been prepared carefully by opening widely all drawers, cabinets and lockers, this powder is thoroughly dusted on the interiors by an especially constructed spray-gun. A routine practice is to dust a thin layer of "Doomsect" upon each shelf of individual compartments and then place a sheet of paper over the powder. Such covering is intended to prevent articles of clothing, food supplies, etc., from coming in contact with the powder. Before closing the exit door, a fine mist of the powder is sprayed upward toward the ceiling and allowed to settle, which usually requires a period of about one-half an hour. In following this procedure, not only all vermin and insects are exterminated through inhaling the pyrethrum contained in the mixture but its effectiveness as an insecticide is continued by means of the poisonous sodium fluoride which is transmitted to the mouths of the insects by their feelers and extremities.

*Germicide.*—For disinfection of rooms which have been occupied by people suffering from infectious or contagious diseases, a solution combining potassium permanganate and formaldehyde is resorted to in order to remove any possibilities of the transmission of infection to other passengers or members of the crews.

This particular method of fumigation is handled in the following manner:

It is necessary to see that all pipe openings to the room are properly sealed and articles of bedding hung in a manner so that they will be penetrated easily by the gas generated. Also, it is a good plan to hang one or two wet sheets in the room in order to obtain the required amount of moisture for penetration.

A crock containing the formaldehyde solution is placed in a pan which has about 2 or 3 inches of water in it. The potassium permanganate crystals are then added to this solution.

A transparent gas having a pungent odor and caustic taste is immediately thrown off; and this gas has a decidedly irritating effect on the skin and the mucous membranes, particularly of the respiratory passages.

For a space of 1,000 cubic feet, 8 ounces of potassium permanganate crystals to 16 ounces of formaldehyde solution are required, and the room should be exposed to the liberated gases for at least 6 hours.

*Ants.*—These are generally brought on board in ships' stores, or in cargo (particularly logs). Ants, seemingly, select decayed wood as the most desirable place for nesting; and from these nests they gradually find their way upward into the superstructure of the vessel. A preparation known as "Ant Destroyer," which is compounded in accordance with the following formula, has proved to be of great assistance in the efforts made to exterminate these pests.

Honey. . . . .	10 $\frac{1}{4}$ lbs.
Water. . . . .	9 pints
Tartaric Acid Crystallized . . . . .	6 grams
Benzoate of Soda . . . . .	8.4 grams

Boil slowly for 30 minutes, and allow to cool. Then dissolve 15 grams of Sodium Arsenite (chemically pure) in  $\frac{1}{2}$  pint of hot water, and permit it to cool. Add the poison solution to the syrup, and stir well.

Small pieces of absorbent cotton are saturated with this solution and placed in small tin ointment boxes which have already been prepared for the free entry of the ants by having a minute opening cut into one side of the lid, or by making a single depression at the edge of the rim. After the lids are attached securely to the tins to prevent undue evaporation or accumulation of dust inside, they are placed in each and every room—generally beneath lockers and drawers, behind wash stands, between walls, and in other places beyond the reach of inquisitive and meddlesome persons. Also, they are placed in convenient and protected places in the coolers, peaks, and holds of the ship. Usually each steamer requires approximately 150 of these tins, prepared and distributed in the manner described above; and each container is replenished with the solution at intervals of about one month.

*Rodents.*—The problem of keeping ships comparatively free of rats, which are known agents in the spread of disease and cause great damage to cargoes, demands knowledge and experience as to their habits and movements as well as concerning the numerous means employed in preventing their ingress and methods utilized in exterminating those which gain access.

Rats gain access on board principally in cargoes of crated merchandise that have been in transit for a protracted time; on unprotected gangways; by means of ropes; or directly from lighters while loading or unloading alongside, and more particularly when the deck is flush with that of the steamer and is allowed to remain in that position over night.

Precautionary measures against infestation are being applied continually by this Company for its own benefit as well as to cooperate fully with the Public Health Service, in an endeavor to maintain ships as nearly free from rats as is possible. There is a routine practice of elevating gangways; placing rat guards on all lines; breasting off from the piers; keeping a close watch on lighters during loading hours and making certain that they have no contact with the steamers at night.

*Rat-proofing.*—This is undoubtedly the most effective means of controlling the infestation of these pests in a permanent way; and such installations must be maintained in first-class condition as they prove useless otherwise. The object is to prevent rats from passing from the holds to the superstructure or from one compartment to another. This was initiated in 1915 by the United Fruit Company and has been in force ever since.

Each and every place which would permit rat harborage such as pipe casings, pipe holes, runways, false walls, open spaces behind desks, lockers and bunks are rat-proofed thoroughly. For this purpose, either tenacious sheet metal with openings not larger than  $\frac{1}{2}$  inch, or heavy gauge wire with not more than  $\frac{1}{2}$  inch mesh, is used.

All wiring on ships is inspected routinely immediately following the arrival of a steamer. After the necessary repairs are completed, another inspection is made to insure that the work has been done in conformity with the regulations.



Rat-proofing which is properly installed and maintained not only confines rats to open spaces on board but also tends to force them to seek habitations more desirable than ships.

The trapping of rats mechanically is resorted to, during intervals between fumigations with cyanide gas, in order to catch those that have gained access in the meanwhile. For this purpose, about 60 snap traps are baited with plain stale bread and placed in coolers, holds, and in the peaks and other parts of the superstructure. They are examined, emptied and rebaited twice daily during the entire stay of the steamer in port.

*Fumigation.*—Cyanide gas (HCN) is undoubtedly the most effective means of fumigation known at the present time for the extermination of rodents and vermin. It is prepared from sodium cyanide, commercial sulphuric acid, and water. The cyanide is purchased in the form of balls called "cyaneggs," each one weighing one ounce. For every ounce of sodium cyanide used, there should be  $1\frac{1}{2}$  fluid ounces of sulphuric acid and 2 fluid ounces of water. The sulphuric acid and water are mixed and placed in containers and, upon adding the cyanide, a gas is immediately formed which is transparent and has no pronounced or characteristic odor. For the fumigations of ships, this gas is employed in proportions of 5 ounces of sodium cyanide,  $7\frac{1}{2}$  ounces of sulphuric acid, and 10 ounces of water to each 1,000 cubic feet of space. Its use is considered extremely dangerous—especially in the hands of inexperienced men—and careful consideration must be given to the selection and training of employees entrusted with the handling of cyanide gas. Primarily, they must be physically sound in every way, thoroughly conscientious, and deeply interested in the class of work. Otherwise, they become careless and permit accidents to occur which may result in serious injury or death to themselves or others about them.

Regular fumigations throughout on all steamships are done at intervals of six months, or at shorter periods if conditions necessitate such action.

The normal time required to prepare a ship for a complete fumigation is about three hours. It is necessary to close and make as nearly air-tight as possible all skylights, ventilators and port holes; and also to see that individual lockers, drawers, cabinets, and communicating doors are properly opened to allow a thorough penetration of the gas. Bed coverings, etc., must be hung up; and the mattresses turned on edge. The holds are prepared by removing all hatch covers between decks, bilge plates and doors leading to coolers or false walls. The top hatch covers are next spaced about two feet apart, and then covered with a heavy tarpaulin which is fastened down to prevent any escape of gas.

The barrels or generators containing the diluted sulphuric acid are then placed in suitable parts of the ship so as to distribute the gas thoroughly and uniformly. As the gas is lighter than air it will find its way to the upper structures in a short time and, for that reason, the heaviest charges are placed on the lower decks. When the aforementioned preparations have been completed, it becomes imperative to clear the entire ship of all laborers, crew members, and other individuals

not directly concerned with the fumigation. A "Danger" sign is put across the gangway, which provides the only means of access to the ship, and this gangway is guarded by a Company watchman who has specific orders to prevent any person other than a member of the fumigation staff from coming on board. The ship is then searched thoroughly to make absolutely certain that no one is aboard; and, when this final precaution has been taken, the gas is then "shot" (as it is termed) in the following order:

The forward crew quarters are usually put under gas first, as they are at the extreme end of the ship and the danger from leakage is consequently lessened. Such quarters are usually fumigated as a whole, because each door connects directly with the main alleyway and the entire compartment can thus be thrown into one section; and it is therefore possible to generate sufficient gas by utilizing one barrel only, which is placed in the alleyway.

It is routine practice to then proceed to the upper deck, where the officers' quarters are usually located; and here there is less danger, also, from leakage. These quarters, as a rule, do not connect directly; and, in consequence, it is necessary to fumigate each room separately. This is done by placing a crock or enameled bucket, containing the solution, in each room; and later dropping the required amount of cyanide in each container, after which the exit doors are closed and sealed thoroughly with gummed paper.

The main superstructure is next in order; and the gas is released first on the top deck. The fumigating employees, working in unison, pass rapidly from one deck to the other setting off charges of the chemicals, until the lowest deck is completely under fumigation; when an exit is made to the outside through the engineers' alleyway.

The gas is then released in the after quarters, which are fumigated usually as one section in the same manner as the forward quarters.

The holds are put under gas lastly, by the use of generators which are placed on the open deck near a hatch through which passes a rubber hose leading well down into the center of the hold. This generator is usually constructed from a barrel, which has an upper compartment, prepared in the form of a hopper, with a trip lever attached so that the contents may be easily dumped into a lower compartment. Dilute sulphuric acid is placed in the lower section of the barrel, and the cyanide is put in the hopper above. The barrel is closed tightly; and its hose connection, leading to the hold, securely attached. The cyanide is then dumped, by means of the trip lever, into the acid. The gas is immediately liberated; and flows through the hose under its own pressure which is amply sufficient to force it to the very bottom of the ship in a concentrated form—thereby producing quick and more effective results.

Without exception, ships remain under the gas fumes for a period of not less than 2 hours. Preparations are then begun for inducing proper ventilation, by removing all temporary obstructions to air passages that were placed to prevent the escape of gas. At this time, it is necessary to don gas masks owing to the fact

that the gas rises slowly and floats about the decks—especially on damp and foggy days, when the humid atmosphere acts as a deterrent to satisfactory ventilation and often prolongs the period of fumigation. After all ports, doors, skylights and ventilators are properly opened, an electrically-operated blower is brought into play; and fresh air is forced into the ship, in order to augment natural ventilation. The blower was especially constructed for this purpose and delivers 5,000 cubic feet of fresh air per minute through an 11½ inch canvas hose which is made in sections 50 feet in length. These individual sections are easily connected, so as to provide any length of hose desired. At times it is necessary to use as much as 300 feet of hose in order to reach distant peaks, lazarets, and holds. This mechanical aid assists materially in removing the gases quickly from all poorly ventilated parts of the ship. Furthermore, the blower removes gas “pockets” from dead air spaces which are liable to prove a menace to workers.

At this juncture, the services of a thoroughly experienced man are required to determine the presence of gas and its strength. This can only be ascertained by walking through each and every room above and below decks in search for possible gas “pockets” in dead air spaces. No gas mask is worn at the time, as this means of inspection is the only sure method of determining whether or not crew members may be permitted to come on board with safety to themselves.

Also, it is necessary to remove all bedding, such as mattresses, blankets and pillows from the quarters to the deck for a thorough airing before the ship is declared safe for the crew to enter their bunk rooms. Such fabrics usually retain a certain amount of the gases, which are liberated very slowly.

Under the “old” method of fumigation, a barrel containing the acid solution was placed in the lower hold and, by means of a bag and string, the cyanide was lowered into the barrel. Such procedure is much more dangerous in practice, as the barrel must be removed at once after opening the hatch; and, in so doing, it is likely to be shaken somewhat, causing gas to be released from the container in sufficient strength to overcome any person handling it. Also, there is danger of leakage from the barrel with consequent damage to any cargo that may be in the holds.

*Water Supply.*—Careful consideration is given to the water supply that is taken on board the steamers at various ports from time to time. It is customary to have complete analyses made of samples of water taken from each ship regularly every six months; or more often, if deemed advisable. In the event of a proved pollution, an endeavor is made immediately to trace the source of the contamination and to notify the proper authorities of all the facts in the case.

It is deemed advisable to clean, cement-wash, and sterilize all tanks containing potable water on each ship every six months. This is done by placing 200 to 300 gallons of water in each tank and adding 500 parts per million of a 10% chlorine solution. After they are washed down thoroughly, the solution that remains is then forced through the filter and entire piping system to destroy all possible means of infection through this source.



*Conclusion.*—The foregoing measures assure us that each ship upon departure from the home port at the beginning of each voyage is clean and free from any source of infection. Such effective sanitary methods reduce the liability of illness on board, and permit each steamer to enter and clear from any port with a minimum loss of time.

## SHORT REPORT OF WORK OF THE SNAKE FARM AT LANCETILLA, TELA, HONDURAS

IRA D. GEORGE, Technician in Charge

Tela, Honduras

The pressing need for a constant supply of specific antivenins as antidotes for the bites of the various poisonous snakes encountered in the coastal regions of Central America and the north coast of South America, led to the development



BUILDINGS OF THE SNAKE FARM AT LANCETILLA, TELA, HONDURAS

On left is the Snake Pit in which the collected reptiles are placed. Middle building is the laboratory where venom extraction takes place. On right, cages for exhibition purposes. The Snake Farm is conducted under a plan of cooperation supported by the H. K. Mulford Co., Philadelphia, by Dr. Thomas Barbour, Director Museum of Comparative Zoology, Harvard University, and by the United Fruit Co., Boston, and its subsidiary, Tela Railroad Co., Tela, Honduras. Photo by Richardson.



*Bothrops atrox*, COMMONLY KNOWN AS "BARBA AMARILLA" AND "FER DE LANCE," IS A MENACE TO THE LIFE OF MEN WHO WORK IN BANANAS OR IN CLEARING LAND

This snake inhabits the low lands and valleys of the coast as well as the pastures and fields of the interior. Action of the poison is haemolytic and the red blood cells and walls of the blood vessels are destroyed, records showing deaths to occur in half an hour. *Antivenin Bothropic* is a specific treatment. This snake, being the largest of the genus *Bothrops*, may attain a length of nine feet.



*Bothrops brachystoma*, COMMONLY KNOWN AS THE "HOG-NOSED SNAKE." OCCURS RATHER RARELY THROUGHOUT HONDURAS

Though the smallest in size of the snakes of this genus brought to this station, the bite has brought death to a guinea pig in thirty seconds, showing the poison acts quicker than that of a larger "Barba Amarilla." Photo by George.

of a cooperative plan by Dr. Thomas Barbour of the Museum of Comparative Zoology, Harvard University; the United Fruit Company; and the Mulford Biological Laboratories in Philadelphia. Their united efforts resulted in the





*Bothrops nigroviridis marchii*, COMMONLY KNOWN AS "TAMAGÁS VERDE"

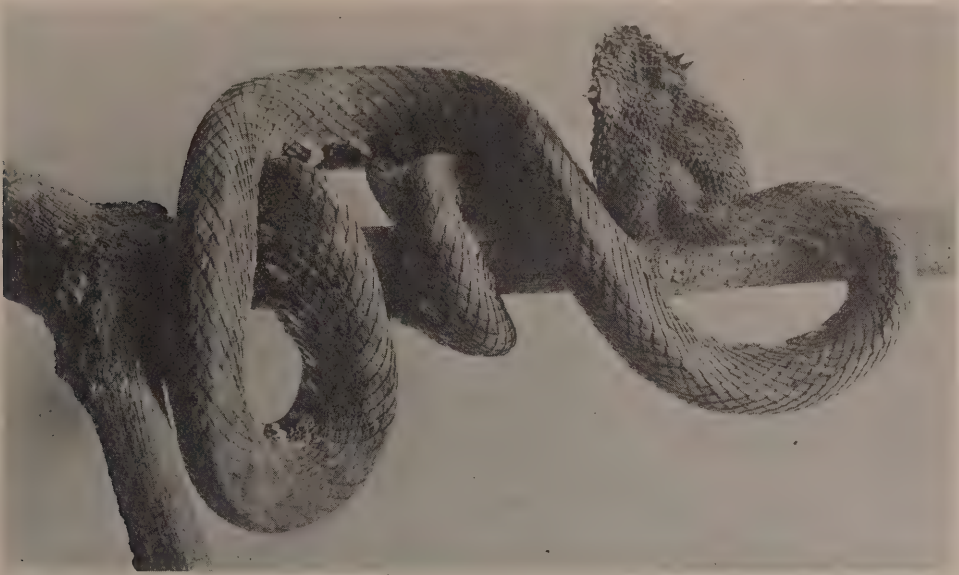
This snake is brilliant green, has a prehensile tail, and lives in trees and low bushes from which it strikes out at its prey and enemies. The few specimens come from around San Pedro, although it is reported at La Masica as well. Deaths have been reported as resulting from the bite of this snake. *Antivenin Bothropic* is an effective treatment of the bite.



*Bothrops nummifera*, COMMONLY KNOWN AS "MANO DE PIEDRA" OR "TIMBO"

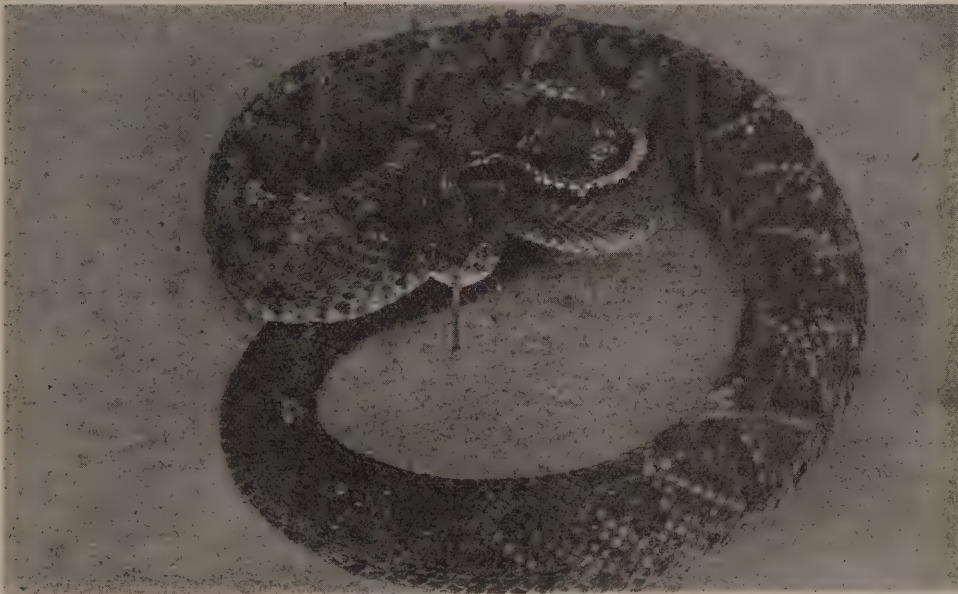
In Honduras this snake seems confined to the hills in the Departments of Santa Barbara, Copan, and Cortez. Belonging to the genus *Bothrops* every member of which is poisonous and can produce death to a person bitten, the bite of this snake is successfully treated with serum known as *Antivenin Bothropic*. Photo by Richardson.





*Bothrops schlegelii*, COMMONLY KNOWN AS THE "PALM VIPER" OR THE "EYE-LASH VIPER,"  
THE LATTER NAME BECAUSE OF TWO SCALES OVER EACH EYE, A VERY  
DISTINGUISHING CHARACTERISTIC

Due to their protective coloration and the adaptation to live in trees and bushes this snake, though poisonous, is little seen throughout Honduras. Bites of this snake may occur on the head, shoulders, and arms of men going through the bush. Species rarely exceed two feet in length. Photo by Richardson.



*Crotalus terrificus*, KNOWN AS THE TROPICAL RATTLESNAKE OR "CASCABEL"

Not found along the low coast, but is confined to the higher, dryer lands of the interior in the pastures and rocky hillsides. Action of the poison being neurotoxic, a specific serum known as *Antivenin Cascabel* is required and successfully neutralizes the poison in the body.

establishment of the Snake Farm at Lancetilla, Tela, Honduras, where the snakes are collected and their venoms periodically extracted; and the Antivenin Institute of America in connection with Mulford's Biological Laboratories, where the antivenins are produced. Snake collections from the different regions (most intensively at Tela) were made and classified; and from the Snake Farm sufficient venom is being obtained from the different poisonous species to supply the requirements.



AN ILLUSTRATION OF THE PATTERN AND COLOR DIFFERENCES OF THE TRUE CORAL AND THE FALSE CORAL SNAKES

The larger one is the True Coral, genus *Micrurus*, and is poisonous. The smaller is one of the King Snakes. The poisonous Coral can be distinguished by noting a single wide black band being bordered by two narrow bands of yellow. The False Coral (smaller snake) has a single narrow yellow band bordered by two narrow black bands, and is not poisonous. The black and yellow coloring is on a red back-ground. Photo by Butler.

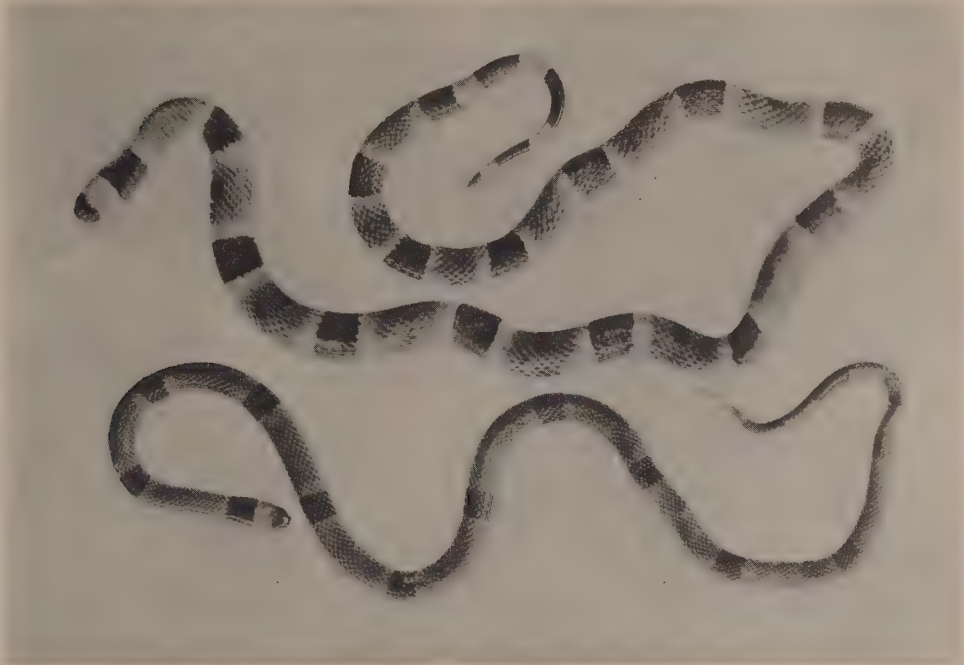
The work is now being extended under the direction of Dr. Barbour to include a study of the incidence, habits, food, environment and geographical distribution of all reptilian forms of life—poisonous and non-poisonous.

The more important venomous snakes found in these localities from which antivenins are prepared are:

(1) *Crotalus terrificus*—the Cascabel or Tropical Rattlesnake. They are found in the foot-hills and pastures of the interior, but not in the coastal plains where the banana plantations are located; and their venom is very fatal.

An antivenin—Cascabel—is now available, and has proved very effective against the bites of these rattlesnakes if administered sufficiently early after the accident.

(2) *Bothrops atrox*—known locally as the “Barba Amarilla”, “Fer-de-lance” or “Terciopelo”—is the most common and dangerous snake in the banana zone. Other species of the same genus are found in the same localities. They are *B. schlegelii*, *B. brachystoma*, *B. nasuta*, *B. nummifera* and *B. nigroviridis marchii*. The last two species are found only in restricted localities—*B. nummifera* in the



TWO SPECIES OF CORAL SNAKES BELONGING TO GENUS *Micrurus*

The Coral Snakes are relatives of the Old-World Cobra group, and their venom though small in amount is very potent. Due to the small mouth, the small fang, and the tendency of the snake to escape rather than strike, the Coral Snakes cause few bites. Of these, only a minority produce death. Both are found throughout Central America, being not rare along the north coast of Honduras. Photo by George.

Departments of Copan, Santa Barbara and Cortes (2 specimens found in Lance-tilla Valley); and *B. nigroviridis marchii* in the Districts of San Pedro and possibly also La Masica. The antivenins made from the venom of *Bothrops atrox* is specific and successful in the treatment of the bites of all species of the genus *Bothrops*, all members of which are poisonous.

At the present time Coral snakes are being collected. The venom from one poisonous species is to be used in making a new specific antivenin as at present there is none available for this species. Only a few bites are reported as caused by this group of snakes.



The value of this work is greatly appreciated, and has resulted in the saving of many lives. We have now specific and effective antidotes against several species of poisonous snakes, whereas hitherto only symptomatic, and in most cases useless forms of medication were used.

The accompanying photographs show nearly all the poisonous snakes of Honduras.

## SNAKE-BITE CASES IN 1929, WITH GENERAL COMMENTS

J. S. CUDLIPP

During the past several years, a special effort has been made to accumulate complete and authentic data concerning snake-bite cases occurring in the Central American countries where the United Fruit Company operates. Special instructions have been issued to all persons in charge of labor units, requesting them to see that all available information is recorded in each and every instance where a snake is alleged to have bitten an employee or other individual residing within or adjacent to the Company's plantations. Special emphasis has been placed upon the necessity of definitely determining the species of the snake inflicting the wound; the approximate size of the snake—whether young or adult; and whether or not there was any evidence that it had recently partaken of food, as the presence of a lump of food in the body of the snake is strong circumstantial information that a small quantity of venom was injected into the human victim. Furthermore, employees have been instructed regarding the proper application of tourniquets, to prevent the recurrence of the serious and sometimes fatal results which have developed in previous years when circulation was entirely interrupted by the application of a tight bandage for an extended period of time; and antivenin has been distributed in such a manner that it is readily accessible to all employees and non-employees working or residing on or near the plantations of the Company and the towns where their activities are centered.

With the object of recording fully all the information collected on the subject during 1929, the individual case reports are given below and followed by a brief summary:

### CHIRIQUI LAND COMPANY

#### CASE 1

*Date, Place, and History of Accident.*—O. R., Panamanian, male, laborer, aged 32 years, was bitten at about 10:00 a.m., January 22, 1929, while cutting underbrush on Zapatero Farm, in the Blanco District. The snake struck him on the dorsal surface of the left foot, between the 2nd and 3rd toes; and, although, the patient did not see the snake, fang marks were found at the site of the bite.

*First-Aid Measures.*—The wound was incised and sucked, and a tourniquet applied immediately after the accident.

*Hospital Admission.*—The patient did not come to the Hospital, but was treated by a Field Dispenser of the Company.

*Physical Examination.*—The patient was examined by the Dispenser, who recorded that there was some pain, and slight swelling and bleeding at the site of the bite; but that no bleeding from the gums was noticed.

*Treatment.*—The patient was given 10 c.c. of Mulford's antivenin, bearing the expiration date of June 27, 1933, at about 12:15 p.m., January 22, 1929; and the wound was dressed with a 1 per cent. solution of potassium permanganate.

*Duration of Illness.*—He was able to return to work 2 days after the accident, at which time he was apparently cured as no symptoms were in evidence and the wound was not infected.

#### CASE 2

*Date, Place, and History of Accident.*—A. S., Panamanian, male, laborer, aged 31 years, was bitten at about 7:00 a.m., June 5, 1929, while cleaning a ditch on Cuajada Farm, in the Progreso District. The patient felt suddenly a very sharp sting on his left ankle; and saw a snake approximately 1 yard in length, which he killed and described as a "X-Bucaraca."

*First-Aid Measures.*—A handkerchief was applied as a tourniquet, immediately after the accident and the patient arrived at the Field Dispensary about 30 minutes later. The Dispenser incised the wound and applied a wet dressing of 1 per cent. solution of potassium permanganate, and administered 1 dose of 10 c.c. of Mulford's antithrotophic serum.

*Hospital Admission.*—The patient was admitted to the Hospital at 10:00 a.m., June 5, 1929.

*Physical Examination.*—The patient stated that he felt a painful sensation at the site of the wound immediately after he was bitten, and an hour later he had a feeling of general weakness and the pain extended "all over the leg." The physical examination was made at the Hospital about 3 hours after the accident. The patient was a moderately well-developed and well-nourished native. The physical examination was negative, except for an incised wound over the left external malleolus which was bleeding; the redness and swelling of the left leg, more marked above the ankle; and considerable bleeding from the gums. His temperature was 103°F., and the pulse rate 112.

*Treatment.*—In addition to the treatment administered by the Field Dispenser, referred to above, the patient was given a second dose of 10 c.c. of Mulford's antivenin, bearing the expiration date of June 27, 1933, at 10:15 a.m., shortly after he arrived at the Hospital. Wet dressings of 1 per cent. solution of potassium permanganate were applied to the site of the bite, and the patient was given 2 fluid ounces of magnesium sulphate.

*Laboratory Examination.*—Blood: negative for malaria; urine: reaction, acid; specific gravity, 1.028; negative except for pus+.

*Duration of Illness.*—Patient remained in the Hospital for 3 days. He was discharged at 7:00 a.m., June 8, 1929, and had recovered entirely from the effects of the bite.

#### CASE 3

*Date, Place, and History of Accident.*—V. V., Nicaraguan, male, laborer, aged 28 years, was bitten at about 8:30 a.m., July 29, 1929, while working on Cuajada Farm, Progreso District. He was picking up a piece of lumber from the ground when he felt "a very sharp cut" in the palmar surface of his left hand. The snake which had bitten him was approximately 3 feet in length and it had not eaten recently. It was killed and brought to the Dispensary, where it was identified as a "Tamaga."

*First-Aid Measures.*—A waist belt was applied immediately as a tourniquet; and as soon as the patient arrived at the Dispensary the wound was incised, sucked, and injected with a solution of potassium permanganate. He was given 10 c.c. of Mulford's antivenin within 45 minutes after the accident.

*Hospital Admission.*—The patient did not come to the Hospital, he was treated by a Field Dispenser.

*Physical Examination.*—Two minute puncture wounds of the palmar surface of the left hand were observed; and blood was oozing from these wounds, as well as from the gums. The Dispenser's records indicate that the patient was suffering from severe pain in the left hand, which was red and swollen. He was kept in the Dispensary under observation and 2 hours later complained of "paralysis" of the left arm, giddiness, weakness, and a very severe pain all over the arm extending as far as the shoulder.

*Treatment.*—In addition to the initial injection of antivenin, referred to above, the patient was given a second dose of 10 c.c., about 11:30 a.m. of the same day. Mulford's antivenin, bearing the expiration date of June 27, 1933, was administered in both instances. Wet dressings of a 1 per cent. solution of potassium permanganate were applied to the wound, and he was also given a dose of magnesium sulphate.

*Duration of Illness.*—At 5:00 p.m. of the same day the patient informed the Dispenser that he was feeling perfectly well and proceeded to his home.

*Comments.*—The Dispenser stated that he could not administer a whole dose of antivenin in the first instance (at 9:15 a.m.) as it was very difficult for him "to find the vein;" and it is probable that little or no antivenin was injected into the patient's veins on the first attempt.

#### CASE 4

*Date, Place, and History of Accident.*—S. B., Panamanian, male, laborer, aged 44 years, was bitten at about 11:30 a.m. on August 27, 1929, while working on Zapote Farm, Blanco District. He was lifting a log out of the ground when he was bitten on the right leg just above the ankle. Another laborer saw the snake, which was approximately 4 feet in length, and killed it; and it was subsequently identified as a "Tamaga." A lump of food, which appeared to be grass, was found in the snake's body.



*First-Aid Measures.*—The 2 wounds were incised, sucked, and injected with potassium permanganate; and 10 c.c. of Mulford's antivenin, bearing the expiration date of June 27, 1933, were administered at 1 p.m. on the day of the accident.

*Hospital Admission.*—The patient was not sent to the Hospital, he was treated by a Field Dispenser.

*Physical Examination.*—The Dispenser observed 2 minute wounds over the external surface of the lower third of the left leg which were bleeding profusely, and the gums were bleeding slightly. The leg was painful, discolored, and swollen.

*Treatment.*—In addition to the treatment recorded under the heading "First-Aid Measures," wet dressings of 1 per cent. solution of potassium permanganate were applied to the site of the injury.

*Duration of Illness.*—The patient remained in the Dispensary until 4:00 p.m. on August 27, 1929, when he proceeded to his home as all the symptoms had disappeared.

#### CASE 5

*Date, Place, and History of Accident.*—G. Z., Panamanian, male, laborer, aged 21 years, suddenly felt a sting in his right ankle while he was clearing a ditch in Guanabanito Camp in Puerto Armuelles, at about 1:30 p.m., October 3, 1929. The snake was brought to the Hospital where it was identified by the Medical Superintendent as a "*Lachesis mutus*" with nothing in its belly.

*First-Aid Measures.*—The patient was sent immediately to the Hospital.

*Hospital Admission.*—The patient arrived at the Hospital about 20 minutes after the accident.

*Physical Examination.*—Patient was a well-developed and well-nourished native. He had been vomiting, and had chills and fever. The physical examination was otherwise negative, except for 2 minute wounds on the right ankle, profuse bleeding from the gums, and some pain at the site of the injury.

*Treatment.*—One dose of 10 c.c. of Mulford's antivenin, bearing the expiration date of June 27, 1933, was injected by vein within 30 minutes after the accident occurred. A tourniquet was applied intermittently, the wounds were incised, and injected with a saturated solution of potassium permanganate; and tincture of digitalis was administered internally.

*Laboratory Report.*—Blood: negative for malaria; urine: reaction, acid; specific gravity, 1.016; albumin, +; otherwise negative; stool: negative; hemoglobin, 85 per cent.

*Duration of Illness.*—The patient remained in the Hospital for 33 days. The extended period of treatment was necessary as the result of a slight infection of his ankle at the point where the wounds had been incised.

#### CASE 6

*Date, Place, and History of Accident.*—L. L., Panamanian, male, laborer, aged 28 years, felt a "sharp cut" in his left buttock while sitting on the grass eating his breakfast at about 11:00 a.m. October 8, 1929, on Espave Farm, Esperanza District. He arose and saw a snake, which was approximately 3 feet in length, in the place where he had been sitting. The snake disappeared before he could kill it, but he described it as a "*Bothrops Atrox*."

*First-Aid Measures.*—The wounds were incised, and injected with a saturated solution of potassium permanganate; and a tourniquet was applied.

*Hospital Admission.*—The patient was admitted to the Hospital at 2:00 p.m. October 8, 1929.

*Physical Examination.*—The patient was nauseated and depressed in spirits. The physical examination was negative, except for a small incision on the left buttock which, according to the patient's statement, was made by the Field Dispenser. There was no bleeding from the gums and the temperature was normal.

*Treatment.*—As soon as the patient arrived at the Hospital he was given an injection of 10 c.c. of Mulford's antivenin, bearing the expiration date of June 27, 1933. Wet dressings of potassium permanganate solution were applied to the site of the injury.

*Laboratory Examination.*—The blood was negative for malaria, and the hemoglobin was 80 per cent.

*Duration of Illness.*—The patient remained in the Hospital for period of 18 hours, when he was discharged as he had entirely recovered.

#### CASE 7

*Date, Place, and History of Accident.*—W. R. J., American, male, Railway Conductor, aged 29 years, was aboard his train in the vicinity of Puerto Armuelles at about 8:00 p.m., November 26, 1929. He had inserted his hand among some banana leaves when he was bitten on the tip of the right index finger.

*First-Aid Measures.*—A tourniquet was applied immediately after the accident.

*Hospital Admission.*—The patient arrived at the Hospital at 8:15 p.m. November 26, 1929.

*Physical Examination.*—There were no general symptoms in evidence and no swelling nor oozing of blood from the site of the wound or other parts of the body. The tip of the finger showed a puncture which might have been caused by the fang of a snake or by a scorpion; and the patient stated that pain was felt in the finger, and extended up the forearm as far as the elbow.

*Treatment.*—One dose of 10 c.c. of Mulford's antivenin, bearing the expiration date of June 27, 1933, was administered at 8:15 p.m. on November 26, 1929. It was not deemed necessary to give any other treatment.



*Duration of Illness.*—The patient remained in the Hospital for a period of 12 hours and showed no other untoward effects. He was then discharged as well.

## CASE 8

*Date, Place, and History of Accident.*—M. S., Panamanian, male, laborer, aged 35 years, was standing under a banana plant on Espave Farm, Esperanza District at about 1:00 p.m. October 21, 1929 when he was bitten on the plantar surface of the right great toe. He did not see the snake.

*First-Aid Measures.*—A tourniquet was applied and the patient was sent immediately to the Hospital.

*Hospital Admission.*—Patient was admitted to the Hospital at 2:00 p.m. October 21, 1929.

*Physical Examination.*—Patient stated that he felt intense pain in the right foot and leg immediately after he was bitten; and that there was some bleeding at the site of the fang marks and also from the gums. When he arrived at the Hospital he complained of pain, feverishness, nausea, and general malaise. The physical examination was negative except for slight discoloration of the right great toe and some swelling of the right foot. There was bleeding at the site of both wounds and also from the gums.

*Treatment.*—One dose of 10 c.c. of Mulford's antivenin, bearing the expiration date of June 27, 1933, was administered subcutaneously in the abdominal muscles at 2:00 p.m. on October 21, 1929; and the foot was washed in a hot solution of potassium permanganate.

*Duration of Illness.*—Patient remained in the Hospital for a period of 3 days and was then discharged as entirely well.

## COLOMBIA DIVISION

## CASE 1

*Date, Place, and History of Accident.*—A. E., was bitten at about 3:00 p.m., Feb. 12, 1929, on a sugar-cane farm in Mamatoco, about six miles from Santa Marta. He was hunting among banana plants and sugar-cane and, when he tried to draw back a branch of a tree, the snake jumped at his face. He attempted to defend himself with his left hand, and was bitten on the dorsal surface, between the thumb and index finger. The snake was approximately four cuartas (about 32 inches) in length, and bears the local name of "Boquidorada" (golden-mouth), although it is also called "Barba amarilla" in some other localities. He was sure that the snake was empty, as he opened it to get the gall-bladder.

*First-Aid Measures.*—The patient stated that, immediately after he was bitten, he felt faint, and vomited. He therefore tied his arm with a tourniquet, and swallowed bile of the same snake, bile of "guatinaja" (a small animal of the opossum family), "contra-cruceta" (a plant that the Indians use for snake-bite), "curarina" (a patent medicine), and about twelve ounces of rum. He declared that he improved after this self-treatment, and went home. He had dinner at 5:00 p.m., and said that he felt well until a pregnant woman came to see him; and from that moment he was very sick, had an extremely high fever, and vomited blood. The patient maintained that blood came out through all the pores of his body, but was stopped by a "secret" that he possesses.

*Hospital Admission.*—The patient arrived at the Clinic at 2:00 p.m., Feb. 13, 1929.

*Physical Examination.*—None was recorded.

*Treatment.*—At 2:00 p.m., on Feb. 13th, the patient was given 10 c.c. of Mulford's antithroptic serum, bearing the expiration date of Sept. 10, 1933. No other measures were taken, except to release the tourniquet and allow the patient to rest. Shortly after the antivenin was injected, he became unconscious and vomited more blood.

*Duration of Illness.*—On Feb. 14th, the patient felt much better. He improved rapidly thereafter until entirely well, although the report does not mention the period of convalescence and merely asserts that the man refused to stay in the Hospital.

## CASE 2

*Date, Place, and History of Accident.*—P. C., a male, Colombian, non-employee, 46 years of age, was bitten at 6:30 p.m., Aug. 9, 1929, at Curinca (a farm about 8 miles from Santa Marta, at the foot of the mountains). The snake was among some branches and other trash which were floating on the water in the ditch where the man was working, and bit him on the middle joint of the ring finger of the left hand. He did not see the snake, but says that, from the appearance of the bite, he is sure that it was a small-sized Pataco (Hog-nose viper).

*First-Aid Measures.*—He drank about 4 ozs. of coffee, without sugar; 2 ozs. of rum, with camphor; and ate a fruit called "ojo de buey."

*Hospital Admission.*—The patient entered the Hospital at 11:15 a.m., on Aug. 11th.

*Physical Examination.*—The patient declared that his hand felt as though it were burning, and pierced by thorns; and that the forearm became swollen as far as the elbow. At the time that he arrived at the Hospital, the hand and arm were still swollen, but he stated that he had had no pain since Aug. 10th.

*Treatment.*—Shortly after he arrived at the Hospital on Aug. 11th, 10 c.c. of Mulford's antithroptic serum, bearing the expiration date of Sept. 10, 1933, were administered. Since Aug. 10th, the patient had been taking "Curarina," which is a special medicine made in Cartagena, alleged to be efficacious for the treatment of poisonous bites.

*Duration of Illness.*—The patient did not remain in the Hospital, but was treated at the Hospital Dispensary at frequent intervals until Sept. 1, 1929, when he had entirely recovered.

## COSTA RICA DIVISION

## CASE 1

*Date, Place, and History of Accident.*—J. T., Costa Rican, male employee, 20 years of age, was bitten on the left hand by a small "Tommy Goffe" snake, at 8:00 a.m., Jan. 19, 1929, while he was working at La Celina, in the Zent District.

*First-Aid Measures.*—One ampoule of snake serum was given at 9:30 a.m., at the farm.

*Hospital Admission.*—He was admitted to the Hospital at 4:45 p.m., on Jan. 19, 1929.

*Physical Examination.*—The report contained no information concerning the findings during the physical examination, but merely stated that the patient felt no ill effects and did not spit any blood.

*Treatment.*—One ampoule of #3 Butantan serum was given immediately after admission, but no other treatment was administered.

*Duration of Illness.*—The patient was quite well when he was discharged on the 22nd of January, 1929.

## CASE 2

*Date, Place, and History of Accident.*—J. R., Nicaraguan, male non-employee, 30 years of age, was bitten a little above the right ankle by a "Terciopelo" snake, on Feb. 12, 1929, at Siquirres.

*First-Aid Measures.*—None recorded.

*Hospital Admission.*—The patient arrived at the Hospital at 4:30 p.m., Feb. 14th, two days after the accident.

*Physical Examination.*—He was in a desperate condition, and had a temperature of 105°F. A tourniquet of strong rags had been applied so tightly around the thigh that circulation was completely checked. The leg was swollen to an enormous size, and gangrene was well advanced below the tourniquet. The patient refused to submit to amputation of the leg.

*Treatment.*—He was given a double injection of #3 Butantan serum immediately after admission to the Hospital. Permanganate of potassium dressings were applied to the leg, and regular stimulant injections were given on Feb. 15th and 16th. He became delirious on the 16th, and was given an injection of morphine and atropine.

*Duration of Illness.*—Death occurred at 11:45 p.m., Feb. 17, 1929.

## CASE 3

*Date, Place, and History of Accident.*—E. R., Costa Rican, male employee, 38 years of age, was bitten on his left ankle by a "Terciopelo" snake, about 1½ meters long, at 8:30 a.m., Apr. 4, 1929, while working on Sara Farm, in the Zent District. The snake was killed.

*First-Aid Measures.*—The patient felt very ill immediately. He commenced spitting blood soon after the accident, and 1 ampoule of snake serum was given at 9:30 a.m., Apr. 4th, and another at 10:30 a.m., Apr. 4th, at the farm.

*Hospital Admission.*—He arrived at the Hospital at 11:55 a.m., on Apr. 4, 1929.

*Physical Examination.*—When he reached the Hospital, he was spitting blood copiously; and the leg was swollen, with a tourniquet cutting deeply into the swollen area.

*Treatment.*—On admission, 1 ampoule of #2 and 1 ampoule of #3 Butantan serum were given intramuscularly, and 1 ampoule of antithroptic serum was given intravenously; and 1 ampoule of #2 Butantan serum was given at 7:15 p.m., and 1 ampoule of #3 at 8:00 p.m., on the same night. Furthermore, the patient was given a 1,000 c.c. saline infusion, at 12:20 p.m., Apr. 4th; calcium chloride, 2 drams t.i.d.; strychnine-digitalis-atropine, 1 tablet every 3 hours; and morphine and atropine injections at 7:00 p.m., Apr. 4th, and at 1:00 a.m., Apr. 5th.

*Duration of Illness.*—Death occurred at 3:30 a.m., Apr. 5, 1929.

## CASE 4

*Date, Place, and History of Accident.*—L. B., Jamaican, male, employee, 37 years of age, was bitten on the tip of the fourth finger of his right hand, by a "Tommy Goffe" snake, at 9:00 a.m., Apr. 18, 1929, while on Bananito Farm, in the Banana River District. The snake was killed.

*First-Aid Measures.*—Although the entire hand became swollen, the patient did not feel sick nor did he spit blood; and 1 ampoule of snake serum was administered at 9:25 a.m., on the farm.

*Hospital Admission.*—He was admitted to the Hospital at 10:50 a.m., on Apr. 18, 1929.

*Physical Examination.*—None recorded.

*Treatment.*—The patient was given 1 ampoule of #3 Butantan serum at 11:40 a.m., and the dosage repeated at 9:00 p.m., Apr. 18th. He received black coffee on the day of admission, and a dose of magnesium sulphate was administered the following morning. Dressings and compresses were applied to his hand.

*Duration of Illness.*—He was discharged from the Hospital on Apr. 29, 1929, at which time the swelling had entirely disappeared and he had fully recovered.



## CASE 5

*Date, Place, and History of Accident.*—J. P., Costa Rican, male, employee, 50 years of age, was bitten on the inside of his left ankle, at 7:00 p.m., Apr. 17, 1929, at Las Lomas, on the Northern R.R. The snake escaped and species not identified.

*First-Aid Measures.*—The victim felt very ill; and his companions in the camp gave him rum, which made him intoxicated, and the next morning he arrived at the Dispensary Car in this condition. He was expectorating blood, which did not cease until midnight, Apr. 18, 1929. One ampoule of snake serum was administered at 7:00 a.m., and another ampoule at 12:30 p.m., on Apr. 18, 1929, at the Dispensary Car in Lomas.

*Hospital Admission.*—The patient arrived at the Hospital at 5:35 p.m., on Apr. 18, 1929.

*Physical Examination.*—None recorded.

*Treatment.*—He was given 1 ampoule of #2 and 1 ampoule of #3 Butantan serum at 9:00 p.m., Apr. 18th. He received black coffee upon admission, and 1 ampoule of fibrogen was administered at 5:40 p.m., Apr. 18th. Calcium chloride, 2 drams every 3 hours, was prescribed; and this medication was continued until the 24th. He was given Pink Tonic pills from Apr. 24th until Apr. 30th; and Chenopodium was administered on the 28th of April, 1929, for intestinal parasites.

*Duration of Illness.*—He was quite well on Apr. 30, 1929, and was discharged from the Hospital.

## CASE 6

*Date, Place, and History of Accident.*—A. M., Costa Rican, male, non-employee, 19 years of age, was bitten on the lower third of right leg, at 9:00 a.m., Apr. 25, 1929, while on Vesta Farm, in the Banana River District. The snake was not killed, nor was the species determined.

*First-Aid Measures.*—The victim did not feel ill and did not spit any blood, although the leg became slightly swollen. He was given 1 ampoule of snake serum, at 11:00 a.m., Apr. 25, 1929, on the farm.

*Hospital Admission.*—The patient entered the Hospital at 3:55 p.m., on Apr. 25, 1929.

*Physical Examination.*—None recorded.

*Treatment.*—Upon admission, 1 ampoule of #3 Butantan serum was administered immediately, and he received black coffee. On the 29th, calomel and magnesium sulphate were given.

*Duration of Illness.*—On May 1, 1929, he was discharged as quite well.

## CASE 7

*Date, Place, and History of Accident.*—I. A., Jamaican, male, employee, 56 years of age, was bitten on the middle finger of the right hand, at 12:30 p.m., June 5, 1929, on Indiana III Farm, in the Siquirres District. The snake was killed, and identified as a small "Terciopelo" by the patient and other workers on the farm.

*First-Aid Measures.*—The finger became slightly swollen and, although no ill effects were felt from the bite, 1 ampoule of snake serum was given at 1:00 p.m., at the Field Dispensary in Siquirres.

*Hospital Admission.*—The patient entered the Hospital at 8:15 p.m., on June 5, 1929.

*Physical Examination.*—None recorded.

*Treatment.*—On admission, 1 ampoule of #3 Butantan serum was administered, and on June 6th, a dose of calomel and salts was given.

*Duration of Illness.*—The patient was quite well, on June 7, 1929, and was discharged from the Hospital.

## CASE 8

*Date, Place, and History of Accident.*—E. B., Costa Rican, male, employee, 20 years of age, was bitten on the right instep, at 9:30 a.m., on Aug. 7, 1929, while working near a large log on the Aurora Farm, in the Banana River District. The snake which inflicted the wound was a "Terciopelo," about 3 meters long. It escaped under the log, but was identified by the patient; and subsequently the snake was killed at the same spot by other laborers, and the identification was confirmed. It is unknown whether the snake had a lump of food in its body.

*First-Aid Measures.*—Directly after the accident, the patient felt very dizzy and had an inclination to vomit, which passed after he received an injection of 1 ampoule of Butantan serum, which was administered at 11:30 a.m., at the farm.

*Hospital Admission.*—The patient was admitted to the Hospital at 1:30 p.m., on Aug. 7, 1929.

*Physical Examination.*—Two bleeding punctures, which were extremely painful and inflamed, were found on the right instep. On admission, the temperature was 97°F.; pulse rate, 66. On Aug. 8th, the temperature was 105.5°F.; pulse, 86; but on Aug. 9th it was normal, and remained so subsequently. The patient did not spit any blood at any time during the course of the illness. The distance between the punctures on his instep indicated that he had been bitten by a very large snake; but the Field Dispenser, who happened to be in the vicinity at the time of the accident, applied a tourniquet in a proper manner.

*Laboratory Examination.*—Stool: uncinaria, +; urine: albumin +, pus +; blood: negative for malaria; hemoglobin, 70%.

*Treatment.*—At 1:45 p.m., on Aug. 7th, 2 ampoules of Butantan and 1 ampoule of Mulford's polyvalent snake serum were given; and at 8:00 a.m., on Aug. 8th, 1 ampoule of Mulford's serum was administered. On Aug. 7th, permanganate of potash was applied to the incised punctures. From



Aug. 8th to Aug. 13th calcium chloride, 2 drams t.i.d., was administered; while dressings of Dakin's solution were applied, at the site of the injury, from Aug. 9th to Aug. 13th. On Aug. 13th, Cheno-podium was given as an anthelmintic. On Aug. 14th he received Pink Tonic pills t.i.d.

*Duration of Illness.*—The patient was discharged on Aug. 19th, at which time his instep was normal and he was feeling quite well.

#### CASE 9

*Date, Place, and History of Accident.*—J. M. C., Costa Rican, male, employee, 32 years of age, was bitten on the index finger of his right hand, at 10:00 a.m., Aug. 7, 1929, while working on Monte Verde Farm, in the Zent District. The victim was holding some dry trash, which apparently harbored the snake. It was killed and identified by the patient and other workers on the farm as a "Tamaga," about 1 foot in length. The body contained no food.

*First-Aid Measures.*—The site of the bite was exceedingly painful from the moment the wound was inflicted, and his finger started to swell. An injection of 1 ampoule of Mulford's polyvalent snake serum was administered on the farm at 10:15 a.m., and another was administered at 11:00 a.m.

*Hospital Admission.*—The patient was admitted to the Hospital at 4:45 p.m., on Aug. 7, 1929.

*Physical Examination.*—The entire right arm was swollen and very painful, but the temperature and pulse were normal. There were two minute punctures, which were scarcely discernible. The patient did not expectorate any blood during the course of his illness; nor did he feel any ill effects other than the pain in his arm, already mentioned.

*Laboratory Examination.*—Urine: albumin +, pus +; stool: negative for malaria and other findings; Wassermann test + + + +; haemoglobin, 65%.

*Treatment.*—In addition to the antivenin administered on the Farm, he received an injection of 1 ampoule of Mulford's polyvalent snake serum at 8:00 a.m., on Aug. 8th. The other medication prescribed was as follows:—On Aug. 7th, magnesium sulphate compresses were applied to the injured hand; Aug. 8th, castor oil, 2 ozs., at 8:00 p.m.; Aug. 8th to Aug. 14th, calcium chloride, 2 drams, t.i.d.; Aug. 15th to Aug. 21st, potassium iodide, 5 minims, t.i.d. From Aug. 16th until the date he was discharged from the Hospital, he received injections of "914" every 4 days.

*Duration of Illness.*—The patient remained in the Hospital for 18 days; and was discharged on Aug. 25th, at which time he was much improved, and the arm was normal.

#### CASE 10

*Date, Place, and History of Accident.*—B. L., Costa Rican, male, employee, 50 years of age, was bitten on the left calf, at 8:30 a.m., Oct. 18, 1929, on Atalanta Farm, in the Estrella District. The snake escaped, but the patient stated that it was a "Terciopelo," about 1 meter in length.

*First-Aid Measures.*—Considering the size of the snake, as indicated by the fact that the 2 punctures were far apart and plainly visible; the patient must have been confused as to the species. He did not spit any blood nor feel sick in any way; although he asserted that he felt a slight shock as he received the bite, which was probably caused from fright. However, 1 ampoule of Mulford's polyvalent snake serum was given by the Field Dispenser, at 10:50 a.m., Oct. 18, 1929.

*Hospital Admission.*—The patient was admitted to the Hospital at 6:30 p.m., on Oct. 18, 1929.

*Physical Examination.*—At the time of admission the pulse rate was 70; temperature, 99; haemoglobin, 55%; blood, negative for malaria. The area, where the 2 punctures were observable, was painful but not swollen.

*Treatment.*—In addition to the antivenin administered as a first-aid measure, 1 ampoule of Mulford's polyvalent snake serum was given at 6:35 p.m., on Oct. 18th. On Oct. 19th, he received 2 drams of calcium chloride, t.i.d., and calomel and salts.

*Duration of Illness.*—On Oct. 21, 1929, the patient was discharged, as he was feeling quite well and had no pain in his leg.

#### CASE 11

*Date, Place, and History of Accident.*—P. M., Nicaraguan, male, non-employee, 28 years of age, was bitten on the posterior surface of the right leg below the calf, at 8:00 a.m., Nov. 7, 1929, while he was working on Blanco Farm, in the Zent District. The snake escaped, but the victim stated that it was a "Taboba," about 30 inches in length.

*First-Aid Measures.*—The patient felt dizzy immediately after the bite, and started spitting blood about 1 hour later. The leg was painful and swollen from the site of the bite to the ankle. He was given 1 ampoule of Mulford's polyvalent snake serum at 9:00 a.m., and a similar dose at noon, Nov. 7, 1929.

*Hospital Admission.*—The patient was admitted at 2:25 p.m., on Nov. 7, 1929.

*Physical Examination.*—At the time of admission, the temperature was 101°F.; and pulse, 80. Two punctures were plainly visible, and the right leg and ankle very much swollen. He was still expectorating blood, and continued to do so until Nov. 9th; and on the 12th and 13th he passed bloody urine.

*Laboratory Examination.*—Blood was negative for malaria; haemoglobin, 65%. The complete findings by urinalysis, during the course of treatment, are recorded below:—

Urine	Nov. 8th	Nov. 11th	Nov. 12th	Nov. 13th	Nov. 14th
Albumin . . . . .	+	+	+	+	+
Sugar . . . . .	—	—	—	—	—
Casts . . . . .	+	+	—	—	—
Pus . . . . .	+	+	+	+	+
Blood . . . . .	+	+	++	++	+

*Treatment.*—In addition to the injections given as first-aid measures, 1 ampoule of Mulford's polyvalent snake serum and 1 ampoule of Butantan #3 were given at 2:30 p.m., on Nov. 7th, and another dose of Butantan #3 was given at 9:30 a.m., on the 8th. The other medication prescribed was as follows:—Nov. 7th: the punctures were dressed with permanganate of potash, a magnesium sulphate compress was applied to the site of the bite, and 3 Compound Cathartic pills were given at 8:00 p.m.; Nov. 8th: alkaline treatment,  $\frac{1}{2}$  oz., t.i.d.; Nov. 13th: fibrogen, 1 ampoule, and 3 Compound Cathartic pills at nighttime; Nov. 8th to Nov. 14th: calcium chloride, 2 drams, t.i.d.; Nov. 15th: 1 dram calcium lactate, and 5 grains phenacetin, t.i.d.

*Duration of Illness.*—The patient remained in the Hospital for 9 days and was discharged on Nov. 16, 1929, at which time he was much improved, and the leg was normal.

## CASE 12

*Date, Place, and History of Accident.*—E. W., Jamaica, male, employee, 31 years of age, was bitten between the thumb and first finger of the left hand, at 8:00 a.m., Dec. 13, 1929, at Bananito Siding, in the Banana River District. While he was handling bananas, he felt something in the trash bite him; and the symptoms indicated that the wound might have been inflicted by a snake.

*First-Aid Measures.*—None was given, but the victim was taken immediately to the Hospital.

*Hospital Admission.*—The patient was admitted to the Hospital at 11:30 a.m., on Dec. 13, 1929.

*Physical Examination.*—The patient stated that he felt a fullness of the head and a sensation as though his eyeballs were bulging. A tiny puncture between the thumb and the first finger was observed, and the area was slightly swollen and painful. His temperature was normal at the time of admission, but rose slightly on the 14th (99°F.); and the pulse was normal.

*Laboratory Examination.*—Urine: albumin +, pus +; stool: uncinaria +; blood: negative for malaria; haemoglobin, 65%.

*Treatment.*—1 ampoule of Mulford's polyvalent snake serum was given on admission (Dec. 13th). Calomel and salts on the 13th, calcium chloride, 2 drams, t.i.d.

*Duration of Illness.*—The patient was discharged on Dec. 16, 1929, and was entirely recovered at that time.

## CASE 13

*Date, Place, and History of Accident.*—I. C., Nicaraguan, female, employee, 32 years of age, was bitten between the third and little toe of the right foot, at 7:00 a.m., Dec. 15, 1929, on Colombiana Farm, in the Siquirres District, when she was approaching the river near the Camp to wash clothes for the day. The snake which inflicted the wound was a blood snake, about 2 feet long; which was killed and found to be empty.

*First-Aid Measures.*—The patient felt very sick immediately, and had an inclination to vomit. A short time after the accident, there was bleeding of the gums and from the site of the bite. A dose of 1 ampoule of Mulford's polyvalent snake serum was given at 9:00 a.m., another at 10:00 a.m., and another at noon, on Dec. 15, 1929, on the Farm and at Siquirres.

*Hospital Admission.*—She was admitted to the Hospital at 7:30 p.m., on Dec. 15, 1929.

*Physical Examination.*—Two punctures could be plainly seen at the site of the injury. They were bleeding profusely, and the gums were also bleeding. The patient was seven months pregnant. (Natives claim that pregnant women have marked resistance to snake-bite.) The temperature was 100°F., and the pulse, 88.

*Laboratory Examination.*—The urine showed albumin +, blood +, casts +, pus +. The blood was negative for malaria. The haemoglobin was 55%.

*Treatment.*—On Dec. 15th, the foot was dressed with permanganate of potash, and on Dec. 16th, 1 ampoule of Mulford's polyvalent snake serum was administered. Calcium chloride,  $\frac{1}{2}$  ounce, t.i.d., was given.

*Duration of Illness.*—The patient remained in the Hospital for 7 days and was discharged on Dec. 22, 1929, at which time the foot was normal and the patient was feeling quite well.

## GUATEMALA DIVISION

## CASE 1

*Date, Place, and History of Accident.*—L. A., was bitten at the base of his left thumb, by a "Barba amarilla," while he was cutting grass at Cayuga Railroad Station, on June 29, 1929. The snake was killed by the patient, and it measured about 9 inches in length.

*First-Aid Measures.*—Tourniquets were applied on the left arm.

*Hospital Admission.*—The patient entered the Hospital at 10:35 a.m., on June 30, 1929, about 24 hours after the accident.

*Physical Examination.*—The patient stated that he felt no symptoms during the first half hour. His hand, arm, and forearm were oedematous and painful at the time of admission, but there was no bleeding.

*Treatment.*—On admission, he was given 1 ampoule of 10 c.c. of Mulford's antivenin serum. He received an injection of 4 c.c. of haemostatic serum at 11:00 a.m., June 30th; and a similar dose was administered at 6:40 p.m., the same day, and again at noon on July 1st. An ice-cap was applied to the upper arm.

*Duration of Illness.*—The patient was discharged, in good condition, on July 7, 1929.



## PANAMA DIVISION

## CASE 1

*Date, Place, and History of Accident.*—The patient stated that, when he stepped in the grass in front of his house on Isla Grande Farm, at 7:00 p.m., Jan. 20, 1929, he felt a sudden sting. No puncture mark was visible, but he indicated that he had been bitten on the dorsal aspect of the right foot between the first and second toes. The animal which inflicted the bite was not seen.

*First-Aid Measures.*—None.

*Hospital Admission.*—The patient was admitted to the Hospital at 3:50 a.m., on Jan. 21, 1929.

*Physical Examination.*—The right foot was painful and swollen within  $\frac{1}{2}$  hour after the accident. Later, pains and swelling developed in the entire right leg up to the groin, where the lymph glands were swollen; and the patient was spitting and vomiting blood.

*Treatment.*—Shortly after admission on Jan. 21st, 8 c.c., of Butantan polyvalent antiothropic serum, bearing the expiration date of 1931, were given. An incision was made over the probable location of the bite, and a potassium permanganate dressing was applied.

*Duration of Illness.*—The patient remained in the Hospital for 13 days, when he was discharged as cured.

## CASE 2

*Date, Place, and History of Accident.*—The patient stated that, while cleaning bananas, on the Bananera Farm of the Sixaola Banana Company, at 5:00 p.m., Mar. 3, 1929, he was bitten by a snake which was lying on a log. He saw the snake, and described it as a coral snake, about 18 inches long. The snake was killed immediately by another laborer, and was apparently empty.

*First-Aid Measures.*—None.

*Hospital Admission.*—He was admitted to the Hospital at 12:00 a.m., on Mar. 4, 1929.

*Physical Examination.*—The patient had been bitten on the left foot dorsal aspect over the region of the first metatarsus, leaving a single fang mark which was approximately 1 cm. in length and apparently deep. He stated that, immediately after the bite was inflicted, the foot became painful and swollen; and an hour later he had a headache and commenced to spit and vomit blood, and the whole leg was painful. At the time of admission, the left foot and leg were swollen, the inguinal glands were swollen and tender, and the gums were bleeding.

*Treatment.*—At 12:30 a.m., on Mar. 4th, he was given intravenously 10 c.c. of Butantan polyvalent antiothropic antivenin, bearing the expiration date of 1932. An incision was made over the bite, and a potassium permanganate dressing applied.

*Duration of Illness.*—He remained under treatment for 16 days, when he had entirely recovered.

## CASE 3

*Date, Place, and History of Accident.*—The patient stated that at 11:00 a.m., Mar. 21, 1929, at the Sixaola Banana Company, while he was chopping cacao, he stepped on a snake which was  $1\frac{1}{2}$  feet long and had dark spots. He asserted that he was bitten three times; and that he killed the snake, but fainted afterwards and left it there.

*First-Aid Measures.*—A tourniquet was applied below the knee.

*Hospital Admission.*—He was admitted to the Hospital at 5:00 p.m., on Mar. 21, 1929.

*Physical Examination.*—On arrival at the Hospital, his foot and leg were slightly swollen, and there was bleeding of the gums. A small fang mark, on the proximal part of the right big toe, was barely visible. The patient stated that the whole leg was painful within  $\frac{1}{2}$  hour after he was bitten; and that later the entire foot and leg became swollen, and he fainted.

*Treatment.*—At 5:15 p.m., Mar. 21, 1929, 10 c.c. of Butantan polyvalent antiothropic serum, bearing the expiration date of 1932, were administered. Potassium permanganate dressings were applied to the foot.

*Duration of Illness.*—He remained in the Hospital for 8 days, when he was discharged as entirely cured.

## CASE 4

*Date, Place, and History of Accident.*—The patient stated that, at 9:00 a.m., Mar. 30, 1929, while he was cutting grass on Farm 4, he was bitten by a snake, which was 1 foot long. It was killed by him, but the species was not identified; and it is not known whether there was a food lump in the snake's body.

*First-Aid Measures.*—A tourniquet was applied around the wrist, and the wound was dressed by a local "Snake Doctor."

*Hospital Admission.*—He was admitted to the Hospital at 1:00 p.m., on Apr. 1, 1929.

*Physical Examination.*—Two small fang marks, 3 mm. in length, appeared on the left hand between the first finger and thumb. The patient asserted that there was some slight pain at the site of the injury shortly after he was bitten; and that, later, there was bleeding of the gums and the urine was bloody.

*Laboratory Examination.*—Urine showed a large number of red blood cells.

*Treatment.*—No record.

*Duration of Illness.*—He remained in the Hospital 3 days only, and was then discharged upon his own request, and against medical advice as there were still some red blood cells in the urine.



## CASE 5

*Date, Place, and History of Accident.*—The patient was picking cocoa on the premises of the Sixaola Banana Company, about noon of April 15, 1929, when he stepped on a snake. He wore a defective shoe and was bitten on the anterior aspect of the third toe on the right foot. The victim stated that it was a "Carmen goffe" approximately 1 foot in length and had no lump of food in its body.

*First-Aid Measures.*—Tobacco juice was applied to the site of the injury.

*Hospital Admission.*—Patient was admitted to the Hospital at 6:00 p.m. on April 15, 1929.

*Physical Examination.*—He asserted that within one half hour after the accident he felt pains in the right foot, and shortly thereafter his gums began to bleed. A single fang mark about 5 mm. long and rather deep was perceptible, and his gums were still bleeding at the time of admission, and for 36 hours subsequently.

*Treatment.*—At 6:15 p.m. on April 15, 1929, the patient was given intravenously 10 c.c. of Butantan polyvalent antiothropic serum, bearing the expiration date of 1932, and the same dosage was repeated at 9:30 a.m. on April 17, 1929. Potassium permanganate dressings were applied to the wound.

*Duration of Illness.*—He was discharged at the end of 8 days hospitalization, as he had recovered entirely from the injury.

## CASE 6

*Date, Place, and History of Accident.*—The patient was lifting a canvas bag up from the grass in the yard of the Overseer's house on La Palma Farm at 9:00 a.m. June 12, 1929, when he was bitten. The patient stated that the snake was approximately 1½ feet in length and that the head resembled that of a "Fer de Lance."

*First-Aid Measures.*—A tourniquet was placed immediately around the forearm, and wet dressings were applied by the Field Dispenser.

*Hospital Admission.*—Patient was admitted to the Hospital at 11:00 a.m. on June 12, 1929.

*Physical Examination.*—There was a scarcely visible single fang mark on the extensor side of the left thumb and the first 4 fingers were numb, but no other symptoms were observed. The patient stated that the wounds bled slightly a short time after he was bitten.

*Treatment.*—At 11:10 a.m. June 12, 1929, 10 c.c. of Butantan polyvalent antiothropic serum, bearing the expiration date of 1932, were administered intravenously. Wet dressings were applied to the wound.

*Duration of Illness.*—The patient remained in the Hospital for 3 days, when he was discharged as cured.

## CASE 7

*Date, Place, and History of Accident.*—The patient was bitten on the lateral side of his leg, just above the ankle, at 2:00 p.m., November 4, 1929, while on Suretka Farm. The snake was killed, but only the head was sent in to the Hospital and in consequence it was impossible to identify the species.

*First-Aid Measures.*—An elastic band was applied above the bite and an ampoule of Butantan polyvalent antivenin, bearing the expiration date of 1931, was given intravenously at 2:30 p.m. on November 4, 1929.

*Hospital Admission.*—He was admitted to the Hospital at 8:00 p.m., November 4, 1929.

*Physical Examination.*—The patient stated that he expectorated a small amount of blood shortly after he was bitten. At the time of admission the foot was slightly swollen, but this might be attributed to the tightness of the elastic band.

*Treatment.*—No treatment other than mentioned above was given.

*Duration of Illness.*—The patient remained in the Hospital for 3 days and was then discharged as his condition was very good.

## CASE 8

*Date, Place, and History of Accident.*—Patient stated that he was bitten on the right side of the right knee, by a snake bearing the local name of "Tommy Goff," at 1 p.m., November 11, 1929.

*First-Aid Measures.*—An intramuscular injection of Butantan polyvalent serum was given by the Field Dispenser at 2 p.m. November 11, 1929.

*Hospital Admission.*—The patient was admitted to the Hospital at 3:00 p.m. November 11, 1929.

*Physical Examination.*—Two small puncture holes were visible, but there were no other symptoms at any time subsequent to the injury.

*Treatment.*—An intravenous injection of Butantan polyvalent serum, bearing the expiration date of 1931, was administered at 3:00 p.m. November 11, 1929.

*Duration of Illness.*—He made an excellent recovery and was discharged November 12, 1929.

## CASE 9

*Date, Place, and History of Accident.*—The patient asserted that he was bitten on the lateral side of his left ankle by a snake at noon December 14, 1929, while on Guabito Farm. The species of the snake was not determined.

*First-Aid Measures.*—At 1:00 p.m. December 14, 1929, the Field Dispenser gave the patient an injection of Butantan polyvalent antivenin, bearing the expiration date of 1931.

*Hospital Admission.*—The patient entered the Hospital at 2:00 p.m. December 14, 1929.

*Physical Examination.*—Two small skin punctures were visible immediately above the left ankle and on the lateral side, but the patient had no symptoms at any time subsequent to the injury.

*Treatment.*—No treatment was considered necessary other than the injection of antivenin administered by the Field Dispenser.

*Duration of Illness.*—The patient remained in the Hospital for 4 days, and was then discharged as no evidence of untoward results from the bite had appeared.

#### CASE 10

*Date, Place, and History of Accident.*—Patient asserted that he was on the porch of his dwelling at Field Farm at 4:00 a.m. on December 21, 1929, when he was bitten by a snake. The species was not determined.

*First-Aid Measures.*—The Field Dispenser gave the patient an intramuscular injection of Butantan polyvalent antivenin at 7:00 a.m. on December 21, 1929.

*Hospital Admission.*—He was admitted to the Hospital at 8:00 a.m., December 21, 1929.

*Physical Examination.*—The patient stated that, during the first half hour, he felt no ill effects from the bite, but subsequently the ankle became painful. At the time of admission the femoral lymph glands were swollen, but there were no other symptoms.

*Treatment.*—In addition to the dose of antivenin administered as a first-aid measure, a second dose was given intravenously at 8:30 a.m. December 21, 1929.

*Duration of Illness.*—The patient remained in the Hospital for 4 days and was then discharged as cured.

#### CASE 11

*Date, Place, and History of Accident.*—The patient asserted that he was bitten below the left ankle on the outer side at 9:00 p.m. December 30, 1929, while on Farm 4, but the species of the snake which inflicted the wound was not determined.

*First-Aid Measures.*—A tight bandage was immediately applied above the site of the bite, and at 9:30 p.m. an intramuscular injection of Butantan polyvalent antivenin, bearing the expiration date of 1931, was administered.

*Hospital Admission.*—The patient was admitted to the Hospital at 10:30 p.m. December 30, 1929.

*Physical Examination.*—No symptoms developed during the first half hour, but subsequently the foot became slightly swollen.

*Treatment.*—No treatment, other than that mentioned under "First-Aid Measures," was deemed necessary.

*Duration of Illness.*—The patient was suffering from malaria and in consequence he remained in the Hospital for a period of 6 days. During this time, however, he showed no ill effects from the alleged snake-bite.

#### CASE 12

*Date, Place, and History of Accident.*—The patient stated that he was in the bush on La Palma Farm at 2:00 p.m. December 31, 1929, when he was bitten below the left ankle by a snake. The species was not determined.

*First-Aid Measures.*—A bandage was applied tightly just above the ankle and an intramuscular injection of Butantan polyvalent antivenin was given at 3:00 p.m.

*Hospital Admission.*—Patient was admitted to the Hospital at 4:20 p.m. December 31, 1929.

*Physical Examination.*—Patient stated that his foot became swollen a short time after he was bitten, and that he had a headache and felt faint. Only 1 puncture wound was visible. At the time of admission the foot was still swollen and the lymph glands were enlarged.

*Treatment.*—He was given an intravenous injection of Butantan polyvalent antivenin, bearing the expiration date of 1931, at 4:30 p.m. December 31, 1929.

*Duration of Illness.*—No untoward symptoms developed, and he was discharged from the Hospital on January 1, 1930.

### TELA RAILROAD COMPANY

#### CASE 1

*Date, Place, and History of Accident.*—The patient stated that he was bitten by an unidentified snake on February 6, 1929, while he was picking up some wood at Freije's Camp in the Guaymas District. He asserted that it was about 1 foot in length; and that it bit him on his left ring finger, although there were no signs of the injury.

*First-Aid Measures.*—None recorded.

*Hospital Admission.*—He was admitted to the Hospital at 6:30 p.m. on February 6, 1929.

*Physical Examination.*—The left hand was swollen, hot and tender. There were no other symptoms.

*Treatment.*—He was given 1 ampoule of antithrotophic antivenin serum  $\frac{1}{2}$  hour after he was bitten, ice bags were applied to the site of the injury, and tincture of opium was administered.

*Duration of Illness.*—He remained in the Hospital 3 days, when he was discharged as cured.

TRUXILLO RAILROAD COMPANY

CASE 1

*Date, Place, and History of Accident.*—G. R., a robust, native, male, employee, working on the Puerto Castilla Dock, was bitten on the index finger of the right hand, on the morning of September 26, 1929, while attempting to remove a small snake from a bunch of bananas. The entire head of the snake had been crushed when it was killed; but, from the markings of the body, it was the consensus of opinion that it was a young boa.

*First-Aid Measures.*—The victim tried unsuccessfully to cut the bite with a dull knife, and then burned it with a lighted cigarette.

*Hospital Admission.*—The patient was admitted to the Hospital on September 26, 1929, about 20 minutes after the accident occurred.

*Physical Examination.*—The patient was frightened, but felt no bad symptoms. There was a single superficial wound of the lateral surface of the terminal articulation of the right index finger. As far as could be seen, there was no bleeding; and the wound appeared to be through the epithelium (thick) only. He stated that the finger was numb and that the anesthesia ran up into the hand a short distance. No tourniquet had been used.

*Treatment.*—The wound was cleaned with ether, and a dressing applied.

*Duration of Illness.*—The patient returned the following day and stated that all the numbness had disappeared and that he felt entirely well.

CASE 2

*Date, Place, and History of Accident.*—This accident occurred about 5:00 a.m., November 26, 1929, in the Puerto Castilla labor town. While reaching for a plate on a high shelf in her house, the patient had been bitten by a 30-inch boa snake. There were two small puncture wounds, 1/16th inch apart, on the radial side of the wrist; but they were not bleeding. The body of the snake contained no lump of food.

*First-Aid Measures.*—Iodine was applied to wound; and a handkerchief was tied around the wrist, but not tight enough to occlude venous circulation.

*Hospital Examination.*—The patient was admitted to the Hospital at 6:15 a.m., on November 26, 1929.

*Physical Examination.*—She was very badly frightened and felt faint. The wounds bled a few drops immediately after the injury, according to the statement of the patient. The physical examination was negative, except for the wounds mentioned and some symptoms of nervousness.

*Laboratory Examination.*—Uncinaria, ascaris and trichocephalus were found in the stool, but the examination was otherwise negative.

*Treatment.*—No treatment was administered, other than that mentioned under "First-Aid Measures."

*Duration of Illness.*—The patient remained in the Hospital for 9 hours, when she was discharged as no further ill-effects had developed.

SUMMARY

1. The 39 cases reported show the following incidence by countries:

Colombia . . . . .	2
Costa Rica . . . . .	13
Guatemala . . . . .	1
Honduras . . . . .	3
Panama . . . . .	20
Total . . . . .	39

2. The anatomical distribution of the bites was as follows:

Right index finger . . . . .	3	Left hand . . . . .	2
Right middle finger . . . . .	1	Left thumb . . . . .	2
Right little finger . . . . .	1	Left hand (between thumb and	
Right foot . . . . .	3	index finger) . . . . .	3
Right great toe . . . . .	1	Left ring finger . . . . .	2
Right third toe . . . . .	1	Left ankle . . . . .	6
Right ankle . . . . .	3	Left foot . . . . .	2
Right leg . . . . .	3	Left leg . . . . .	1
		Left buttock . . . . .	1



Left Extremities . . . . .	19
Right " . . . . .	16
Unrecorded sites . . . . .	4

3. A special effort has been made to gather reliable statistics concerning the species of snakes responsible for snake-bite cases reported in the Central American localities where the Company operates, but despite the emphasis placed upon the desirability of recording such data the results have been disappointing as indicated by the following tables:

No. of cases in which the species of snake was reported . . . . .	23
" " " " " snake was not seen by anyone. . . . .	8
" " " " " species of snake was seen but not reported . . . . .	8
Total. . . . .	39

Of the 23 cases in which the species or native name of the snakes were reported, the incidence of the various species was:

<i>Bothrops atrox</i> (Local names: Barba Amarilla, Yellow-Jawed Tommy Goff, Terciopelo, Velvet Coat, Boquiderada, Golden Mouth, Fer-de-lance). . . . .	9
<i>Bothrops brachystoma</i> (Local names: Hog-nosed Viper, Tamaga). . . . .	3
<i>Bothrops schlegelii</i> (Local names: Toboba, Bocaraca, Sleeping Tommy Goff, Horned Palm Viper). . . . .	2
<i>Lachesis mutus</i> (Local names: Bushmaster, Mapana). . . . .	1
Species undetermined, but identified by local names (Tommy Goff 3, Blood-snake 1, Coral-snake 1, Carmen Goff 1, Boa 2). . . . .	8
Total. . . . .	23

In 15 of these 23 case reports it is stated that the snake which inflicted the bite was killed; in 3 it is mentioned that the snake was not killed; while in 5 it is unstated whether the snake was killed or escaped.

The degree of reliability of the identifications in the 23 case reports which record the species of the snakes involved may be briefly summarized:

Identity established by Medical Superintendants . . . . .	2
" " " native Dispenser . . . . .	1
Species reported by laborers, who killed the snake . . . . .	8
" " " " , who saw but did not kill the snakes . . . . .	3
Reports fail to show the persons who identified the species or the means of identification . . . . .	9
Total. . . . .	23

4. The symptoms which were recorded in the reports for 39 cases are listed below:

1. Pain at site of bite . . . . .	18
2. Pain extending partially or entirely over the limb infected. . . . .	11
3. Swelling at site of bite . . . . .	19
4. Swelling extending partially or entirely over the limb infected . . . . .	12
5. Discoloration at site of bite . . . . .	3
6. Discoloration extending partially or entirely over the limb infected. . . . .	2

7. Bleeding at site of bite . . . . .	9
8. Bleeding from gums . . . . .	10
9. Vomiting blood. . . . .	7
10. Numbness at site of bite. . . . .	3
11. Inguinal or lymph glands swollen. . . . .	3
12. Elevated temperature. . . . .	8
13. Increased pulse rate. . . . .	4
14. Headache . . . . .	2
15. General weakness. . . . .	12
16. State of unconsciousness . . . . .	1
17. Blood in urine . . . . .	4
18. Gangrene . . . . .	1
19. Puncture wounds visible . . . . .	18
20. No symptoms . . . . .	9

Nine of the 39 cases exhibited no symptoms; while, as will be obvious from the above table, most of the remaining 30 cases showed two or more of the symptoms listed.

5. The relative seriousness of the symptoms observed in the respective cases, including those in which the species of the snakes were not identified as well as those in which the reports mentioned the identities (even though doubtful, due to the limited knowledge of the persons reporting the species) are indicated in the following table:

	Fatal	Seriously Ill	Painful and Marked Symptoms but Not Dangerously Ill	Mild Symptoms	Very Mild Symptoms	No Positive Symptoms
<i>Bothrops schlegelii</i> . . . . .	—	—	—	1	—	—
<i>Lachesis mutus</i> . . . . .	—	—	—	—	1	—
<i>Bothrops atrox</i> . . . . .	2	—	4	—	2	2
<i>Bothrops brachystoma</i> . . . . .	—	—	3	—	—	—
Species undetermined, but identified by local names . . . . .	—	—	2	2	—	4
Total . . . . .	2	0	9	3	3	6
Snakes not identified . . . . .	0	0	5	6	2	3
Grand Total . . . . .	2	0	14	9	5	9

With the purpose of determining the relationship, if any, between the mildness or severity of the symptoms and the time that the antivenin was administered, the following table has been prepared:

	No. of cases	Within 30 Minutes	30 Minutes to 1 Hour	1 Hour to 2 Hours	2 Hours to 3 Hours	3 Hours to 4 Hours	4 Hours to 5 Hours	5 Hours to 6 Hours	6 Hours to 12 Hours	12 Hours to 24 Hours	More than 24 Hours	Not Adm.
Fatal Cases. . . . .	2	—	1	—	—	—	—	—	—	—	1	—
Painful Cases . . . . .	14	1	3	1	2	—	—	—	4	2	—	1
Mild Cases . . . . .	9	4	—	1	—	2	—	—	1	—	1	—
Very Mild Cases. . . . .	5	2	—	—	3	—	—	—	—	—	—	—
No Positive Symptoms . . . . .	9	2	2	—	1	1	—	—	1	—	—	2

Three patients did not receive injections of antivenin. Two had been bitten by snakes known to be of a non-poisonous species, while the other was a non-employee who did not conform with the medical advice given to him.

Seven (50 per cent) of the 14 cases showing painful or marked symptoms received antivenin within 3 or 4 hours after they were bitten.

Twelve (86 per cent) of the 14 cases showing mild or very mild symptoms received antivenin within 3 or 4 hours after they were bitten.

Six (86 per cent) of the 7 cases showing no positive symptoms (excluding the 2 bitten by snakes known to have been non-poisonous) received antivenin within 3 or 4 hours after they were bitten.

One (50 per cent) of the two cases which proved fatal received antivenin within 3 or 4 hours after he was bitten.

The average period of time that patients were under treatment or retained in the Hospital for observation was 6 days. The following table shows the duration of illness or observation:

Less than 24 hours . . . . .	5	11 days . . . . .	1
1 day . . . . .	3	12 days . . . . .	1
2 days . . . . .	2	13 days . . . . .	2
3 days . . . . .	10	16 days . . . . .	1
4 days . . . . .	2	18 days . . . . .	1
5 days . . . . .	1	22 days . . . . .	1
6 days . . . . .	1	33 days . . . . .	1
7 days . . . . .	2	Unknown . . . . .	1
8 days . . . . .	3		—
9 days . . . . .	1	Total . . . . .	39

In many instances, as will be noted by referring to the individual case reports, the symptoms had disappeared completely some time before the patient was discharged.

#### FATAL CASES

Special attention has been given to snake-bite case reports since 1927; and the incidence and mortality rates of the recorded cases for the respective years are given below:

	No. of Cases Recorded	Deaths	Fatality Rate (Per cent.)
1927	19	1	5.26
1928	46	4	8.70
1929	39	2	5.13
Total . . . . .	104	7	6.73

Brief reviews of the fatal cases follow:

CASE 1, 1927.—This accident occurred on a farm over 50 miles from the Hospital. The man was admitted in an unconscious state. The snake-bite was located on the left middle finger, which was gangrenous; and dark, bloody fluid was discharging from the fang-puncture wounds. There was also bleeding from all mucous membranes. He died without regaining consciousness.



CASE 1, 1928.—The species of the snake which inflicted the bite was not determined. Nine hours subsequent to the accident, an intramuscular injection of antiophidic serum was given; and 23 hours after the accident, an intravenous injection of 1 ampoule of antiothropic serum was administered. The patient became progressively worse and died 6 days after he was bitten.

The snake struck the base of the right thumb on the dorsal surface. The patient complained of pain in the right arm soon after the accident and expectorated a small amount of blood-stained saliva. The symptoms recorded were:

2nd day.—Still expectorated some bloody saliva.

3rd day.—Bloody expectoration had ceased. The swelling of the right arm had extended into the pectoral region. There was an annular discoloration of the thumb and index finger. Toward evening he became delirious and had difficulty in speaking.

4th day.—Delirium continued; patient was unable to articulate, and had difficulty in swallowing. Nystagmus was present; there was muscular twitching of the right side of the face; and the right pupil was dilated.

5th day.—Restless and had a sighing type of respiration.

6th day.—The patient died at 8:00 a.m. on the 6th day.

The recorded physical examination showed:

*"Oozing of blood from the gums. Blood pressure 125/70. The right hand was greatly swollen. An incision about one inch long was present over the dorsal surface of the base of the right thumb. A tourniquet was found loosely applied about the lower end of the right forearm. The entire arm was swollen to the level of the shoulder. The arm was painful throughout the swollen area. There were numerous blebs on the anterior surface of the arm."*

While the species of the snake was not determined, the symptoms which developed during the course of illness seem to indicate that the fatal result was due primarily to the bite of a poisonous reptile.

CASE 2, 1928.—The patient was alleged to have been bitten on the left foot by an unknown species of snake 24 hours before his admission to the Hospital. He was given 2 doses of antiothropic serum at the time of admission. The only symptoms recorded were bleeding from the gums. The patient became delirious and died 15 hours after he entered the Hospital. The case report did not mention whether or not the illness was complicated by improper application of a tourniquet or any other associated conditions which might have been primarily or secondarily responsible for the fatal result.

CASE 3, 1928.—The case report read as follows:

*"Accident occurred at San Cecilio, Banana River District, at 9:00 a.m., Nov. 20, 1928.*

*"First Aid.—A dose of antivenin was given 15 minutes after the accident.*

*"Hospital Admission.—12:40 p.m., Nov. 20, 1928. Two doses of antivenin were given at the time of admission, and repeated at 6:20 p.m. Nov. 20th, and at 1:00 a.m., Nov. 21st.*

"Symptoms.—The arm and shoulder were swollen, painful and discolored. Blisters appeared on the hand. There was bleeding from the gums and the patient expectorated bloody sputum. The urine was dark in color. Coma developed on the 24th of Nov.

"Result on Discharge.—Died, 9:35 a.m., on Nov. 24, 1928."

CASE 4, 1928.—The victim was bitten by a "bushmaster" or *Lachesis mutus*, at 10:00 a.m., September 18, 1928. He tied a string around his leg above the knee at once; and intense pain developed in his entire leg immediately after the accident, and was followed closely by swelling and discoloration of the limb. One hour after the accident he started to vomit blood and bleed from the nose. At the time of admission to the Hospital, some 4 hours after he was bitten, the patient was nearly pulseless, and frequently vomited bloody, foamy masses. The treatment which he received and the progressive development of the condition, as abstracted from the case report, is detailed below:

"Treatment Given.—2:15 p.m., September 18, he was given 10 c.c., of polyvalent Butantan antithrotophic serum intravenously; and this dosage was repeated at 7:00 p.m., September 18, and again at 10:00 a.m., September 19. He received 1,000 c.c. of normal saline, administered hypodermically. During the first few hours subsequent to his admission his pulse improved slightly; but he complained of an insatiable thirst, and had intense pains in the right leg and in the right lower quadrant of the abdomen. The discoloration of the skin increased, and on the morning of September 19 it was a dark purplish color with the epidermis detached from the subcutis by large blisters which were filled with a bluish haemorrhagic fluid. The patient's pulse became progressively weaker, until his death. There was no haemorrhage during his last hours."

The patient died 20 hours after he was admitted to the Hospital, or 24 hours after the accident occurred.

CASE 1, 1929.—The patient was alleged to have been bitten by a "Terciopelo" snake, on Feb. 12, 1929. He did not come to the Hospital until 2 days later, when he was in a desperate condition and had a temperature of 105°F. The case report states:

"A tourniquet of strong rags had been applied so tightly around the thigh that circulation was completely checked. The leg was swollen to an enormous size, and gangrene was well advanced below the tourniquet. The patient refused to submit to amputation of the leg.

"Treatment.—He was given a double injection of #3 Butantan serum immediately after admission to the Hospital. Permanganate of potassium dressings were applied to the leg; and regular stimulant injections were given on Feb. 15th and 16th. He became delirious on the 16th, and was given an injection of morphine and atropine.

"Duration of Illness.—Death occurred at 11:45 p.m., Feb. 17, 1929."

CASE 2, 1929.—The patient was bitten by a "Terciopelo" at 8:30 a.m., April 4, 1929. He felt very ill immediately and commenced spitting blood soon after the accident. Antivenin was administered as follows:

9:30 a.m., April 4, 1929, 1 ampoule.

10:30 a.m., April 4, 1929, 1 ampoule.

11:55 a.m., April 4, 1929, 1 ampoule #2 Butantan serum intramuscularly; 1 ampoule #3 Butantan serum intramuscularly; and 1 ampoule of antithrotophic serum intravenously.

7:15 p.m., April 4, 1929, 1 ampoule #2 Butantan serum.

8:00 p.m., April 4, 1929, 1 ampoule #3 Butantan serum.

When he arrived at the Hospital 3 hours and 25 minutes after he was bitten, he was spitting blood copiously; and the leg was swollen, with a *tourniquet* cutting deeply into the swollen area.

Death occurred at 3:30 a.m., April 5th, 19 hours after the accident, despite the fact that everything possible was done to save the patient.

#### CONCLUSIONS

1. Reliable and authentic data concerning the number of people bitten by poisonous snakes in tropical countries, and the seriousness of the symptoms resulting from such accidents, are difficult to obtain.

2. Among a population of approximately 150,000 people dwelling in the West Indies and Central America, the larger percentage of whom labor and reside in agricultural areas, only 104 verified or alleged snake-bite cases have occurred during a period of 3 years—23 per 100,000 per annum.

3. In 104 patients bitten or alleged to have been bitten by venomous snakes, only 7 deaths occurred. The mortality rate was 1.6 per 100,000.

4. Of the 7 fatal cases, in only 2 can the lethal results, with any great degree of certainty, be attributed directly to the venom injected by the snakes; while in 3 instances the details were too scant to draw any conclusions, and in 2 cases improper first-aid measures adopted by the patients or their friends were probably responsible for the unfortunate termination.

5. Records of "*snake-bite cases*" are prone to be defective for several reasons—(a) unless the snake is seen, the bites may have been inflicted by other animals than snakes; (b) the identification of the species of snakes inflicting the wounds may be unreliable; (c) the amount of venom injected into the human victim can only be conjectured; (d) the first-aid measures administered are frequently subject to adverse criticism; (e) fear and shock may sometimes be determining factors; and (f) the patient may seek proper medical treatment after the condition has progressed to a stage where all known methods of treatment will prove inadequate.

#### ADDENDUM

In Vol. III, No. 2, of the Bulletin of the Antivenin Institute of America, issued July, 1929, appeared an article by Mr. R. H. Hutchison, Secretary of the Institute, entitled "On the Incidence of Snake-Bite Poisoning in the United States and the Results of the Newer Methods of Treatment." The information



contained therein is of special interest and value to residents of districts where poisonous snakes are encountered; and the reader will find below an abstract of that section of the paper which bears the sub-heading "The Newer Treatment of Snake-Bite Poisoning in the United States."

This review of the 1928 case reports brings out facts and figures entirely in accord with the recommendations for the treatment of snake-bite poisoning based on the experience of physicians who have had the most extended opportunities for clinical observation. We have had the benefit of the advice of men like Major R. E. Scott, M.D., Fort Sam Houston, Texas, Dr. Dudley Jackson of San Antonio, Texas, and Col. M. L. Crimmins, U. S. A. Retired, who have probably seen more cases of snake-bite poisoning than any other physicians in the United States, and with their advice and help the following directions have been formulated.

#### FOR THE VICTIM

##### *What to do when bitten*

1. Apply a ligature or tourniquet a few inches above the bite. For this purpose use a rubber garter, a piece of small rubber tubing, a handkerchief, cord, or even a shoe-string. Do not bind the limb too tightly, but just tightly enough to retard circulation returning through the veins toward the heart. The sole object of the tourniquet is to delay absorption of the poison into the general circulation, but if it is applied too tightly or kept on too long, gangrene is likely to set in, with resulting destruction of the flesh in the affected area. It is important, therefore, to release the tourniquet every 10 or 15 minutes for about a minute at a time.

2. If you have Antivenin with you, read carefully the directions on how to prepare the syringe and how to make the injection. Remember that venoms of North American snakes are usually slow in acting. Do not allow fear or agitation to make you overlook important points.

3. When the syringe has been made ready, proceed at once to inject the entire contents of the syringe under the skin.

4. The tourniquet should then be released.

5. If the bite has been inflicted by a large snake, particularly by the Texas Rattler or the Florida Rattler, and if the symptoms are severe and develop rapidly, the Antivenin treatment should be supplemented by incision and suction.

##### *Other first-aid measures*

6. If Antivenin is not at hand, there are only two other first-aid measures that have proved of value. These are incision and suction, both of which have been used in Texas in cases of bites inflicted by the Western diamond-back rattlesnake. Make a cross-cut incision at each fang mark. For this purpose use a sharp, clean knife or razor blade and make the cut all the way through the skin, that is, about  $\frac{1}{4}$  of an inch deep and  $\frac{1}{2}$  inch long. This allows some of the poisonous fluids to escape.

The removal of toxic fluids may be increased by applying strong suction over these incisions. The suction may be done mechanically if some apparatus, such as a breast pump, is at hand. Suction should be continued for 20 minutes out of each hour over a period of fifteen hours.

7. In any case obtain the best medical attention as soon as possible.

##### *Don'ts*

Don't run or get overheated. Don't take any alcoholic stimulants. Circulation, increased by exercise or by alcohol, serves to distribute the poison much

more rapidly through the body. Don't injure the tissues by injecting potassium permanganate, which is now known to be of no value as an antidote. Do not depend upon snake-bite "cures" or home remedies commonly used. They are of no value. Do not cauterize the site of the bite with strong acids or the like.

#### FOR THE PHYSICIAN

##### *Special directions*

If the victim has not received an injection of Antivenin, it is important to inject the contents of one syringe as soon as possible. At the same time, release the tourniquet, if one has been applied.

Repeat the injections every one to two hours unless and until symptoms are markedly diminished. In order to hasten the absorption of the serum, intramuscular injections are advised, and, in severe cases and those seen late, intravenous injection is recommended. In small children, when intravenous injection is difficult, the Antivenin may be given intraperitoneally. In shocked cases, physiological salt solution intravenously and blood transfusion are supplementary measures of life-saving value. For weak pulse and threatened heart failure give caffeine or strychnine.

If incisions have been made at the site of the bite, the wounds should be irrigated with a 1 or 2 per cent salt solution (not normal saline). The application of strong suction may be continued over these incisions, if the symptoms and condition of the patient indicate the necessity of pushing the treatment. Otherwise, apply a hot application of 1:10,000 mercury bichloride or a strong magnesium sulphate solution.

##### *Extra precautions*

It sometimes happens that after the first shock and reaction has passed, the patients will show marked improvement. Some fatalities from snake-bite are plainly caused by an undue sense of security following the observation that most patients do well for the first 15 hours. Even though the general symptoms may be mild, it is important to keep the patient under close observation for at least 24 hours, and active treatment should be continued as long as the swelling is progressing. Repeat the injections of Antivenin every 1 or 2 hours if the swelling is increasing. The danger is always in under-treatment rather than in over-treatment.

In treatment of snake-bite in children it is important to double the initial adult dosage. The reason for this is that a mathematical relation exists between the weight of the body and the amount of venom which it can normally neutralize and dispose of without serious injury, although the amount injected by the snake is approximately the same. The smaller and lighter the body of the victim, the less venom it can withstand, and the greater the excess of venom over the normal body resistance. Therefore, if the victim be a young child, there is much more venom requiring neutralization by the serum.

While the venomous species of snakes vary in different localities and countries, and specific antivenins are required, the general measures recommended by Mr. Hutchison are indicated in the treatment of all cases of snake-bite poisoning.

## BOA BITE CASE REPORT

OTTO TIEMANN BROSIUS, M.D., D.T.M. &amp; H., F.A.C.P.

Chiriqui Land Company Hospital

Puerto Armuelles, Panama

A Panamanian laborer, mestizo, came to the Out-Patient Clinic and asserted that, while cutting grass, he was bitten on the calf of the leg by a large boa. He killed the boa with his machete, and found that it measured about 10 feet. He stated that he knew that he should not have killed this large snake, as it is reputed to destroy poisonous serpents; but that, under the influence of the sudden pain, he lost his self-control as most people would have done. He did not want to come to the Dispensary for treatment, as he recognized the species of snake and knew that it was not poisonous; but his farm overseer insisted that he should consult one of the doctors.

The impressions in the calf of the leg showed irregular teeth markings from several rows of teeth, and there were no apparent fang marks. The teeth-wounds, extending from one side of the calf of the leg to the other, measured a distance of  $3\frac{1}{2}$  inches; and were arranged as shown in the illustration.



## BOOK REVIEWS

Rogers (Leonard) (C.I.E., M.D., B.S. (Lond.), F.R.C.P., F.R.C.S., F.R.S., Major-General Indian Medical Service, Ret., Medical Adviser to the India Office.) *Recent Advances in Tropical Medicine*. 2nd Edition.—pp. + 439. With 16 text figs. 1929. London: J. & A. Churchill, 40 Gloucester Place, Portman Square. (12s. 6d.)

Physicians connected with the United Fruit Company, as well as others who attended the International Conference on Health Problems in Tropical America, by invitation of the Medical Department of that organization, at Kingston, Jamaica, in 1924 will remember, among the many outstanding pleasures, and



events of notable scientific interest, the presence of Sir Leonard Rogers, F.R.S. His wide knowledge of medicine and surgery in general, and of the problems of Tropical Medicine in particular; his pleasing personality, the strength with which he maintained his own convictions, his willingness to admit that *errare humanum est*, and at times, like his fellow mortals, he had done so; his keenness and courtesy in debate, all combined to produce a lasting and most favorable impression on those fortunate enough to have known him on that occasion.

Any contribution of his, and especially one concerned with Tropical Medicine, will be looked forward to with pleasure and read with profit. From time to time there is a genuine need for an authoritative summary of the rapid advances in this field. That admirable and acutely critical review, "Tropical Diseases Bulletin" keeps its readers fully informed and up to date, but a handy volume which compresses within four hundred pages all of the essential headway made during the past decade, will find a welcome resting place in the library of him who desires a convenient and accurate source of reference.

To the physicians of the United Fruit Company, and others in the American Tropics, those chapters which deal with diseases known to us are of the greater interest. But Sir Leonard is a facile writer with an easy style, and in his account of Kala Azar he tells of one of the great epics of medicine.

The section on malaria is full and complete, and the work done by the Medical Department of the Company receives ample notice. The author says that the value of plasmochin is uncertain. There is an excellent discussion of the prophylactic value of quinine, and it seems that this use of the drug is of distinct service in hyperendemic areas and foci, especially of malignant tertian. It does not prevent infection, but reduces the severity of the attacks. This was also the opinion of the early workers in the Canal Zone, and Maj. Paul McNabb not long ago gave a very useful demonstration in a number of United States troops sent into infected parts of the Canal Zone and Panama on maneuvers. There was but little malaria in the field, but plenty after the return to sanitated areas and the discontinuance of quinine.

There is also a concise discussion of the advisability and efficacy of intra-muscular and intravenous use of quinine. Macphail's extensive experience in Guatemala with the laborers of the Company is favorably noted. The reviewer confesses to a little surprise in reading, with reference to intravenous injections, that

"Extensive experience has proved that the use of 100 or more c.c. of fluid for each dose, as advised by some is unnecessary. . . . but a dose of ten grains can be given in 10 to 20 c.c. of water in one or two minutes."

The advantage of running in a high dilution over a period of fifteen to thirty minutes is in the safety of this method, as the infusion can be stopped at the first indication of heart failure, and cautiously resumed. When the entire dose is rapidly given in low dilution, if heart failure occurs, it is sudden, cannot be controlled, and sometimes is quickly fatal.

The author notes that the parthenogenesis theory of Schaudinn has been sub-

jected to much recent criticism. Long ago the reviewer published a translation of Bignami's paper, which thoroughly exploded that hypothesis; and also in 1913, "Notes on the Etiology of Relapse in Malarial Infections" in which the so-called parthenogenetic forms were shown to be either a double infection or atypical segmentation, with a plate to show the same. Schaudinn's parthenogenesis is in the same category as his "gemmation" in *E. histolytica*, and Mary Lawson's "sporulating crescents" in the peripheral blood.

The increasing use of the thick film method for diagnosis is noted with approval. The reviewer was one of the first to confirm Ross's method. Barber's simple, rapid and accurate technique as used by Herbert Clark in his malaria surveys, unfortunately is overlooked.

In blackwater fever the continuance of the fever after the disappearance of the parasites is attributed to toxemia, which J. Thomson concludes is produced by the patient's own hemolysed blood. The problem of whether or not to give quinine is amply discussed. Sir Leonard concludes that this depends essentially on the presence or absence of malarial parasites in the circulation, and to some degree on their numbers. He also agrees with those who have found that the infected erythrocytes are the first to disappear. It is for this reason that the reviewer never gives quinine during the period of hemoglobinuria. If parasites are present at the time of examination, they will assuredly disappear promptly whether or not quinine is given, so why take a chance on aggravating an already serious condition? The number of the asexual cycle found at autopsy when quinine has been withheld, is too small to do any damage. There is, of course, nearly always some residual malaria, which generally relapses if quinine is not given during convalescence. The reviewer has never been able to attribute any benefit to the exhibition of quinine during the attack, and himself feels certain that at times irreparable damage has followed.

Amoebiasis is thoroughly dealt with, and it is remarkable how so much valuable information has been collected in the thirty-five pages devoted to this, and amoebic hepatitis and liver abscess. Dobell's magnificent demonstration of the complete life cycle is noted, and the original paper should be read by those interested in the subject, which was reviewed in last year's Annual Report. E. Brumpt's address before the Anniversary meeting of the Royal Society of Tropical Medicine and Hygiene in 1928 is also mentioned. This paper, and the subsequent discussion, are highly important to those who have to do with this trying infection, and whether or not we agree with Prof. Brumpt, he has certainly given us food for thought. The publications of Kofoed and his co-workers in California with respect to amoebae in the marrow in osteo-arthritis and the glands in Hodgkin's disease, are stated to depend upon "highly technical cytological studies of fine sections of the tissues."

The statement is made that the three non-pathogenic human entamoebae, *nana*, *butschlii* and *fragilis*, are not of much importance to the practising tropical physician. With this the reviewer can not concur. These three species have

daily given him for years, and yet give him, plenty of trouble in establishing a proper diagnosis.

The author sets forth strong and valid arguments for the use of emetin in the pre-suppurative stage of amoebic hepatitis. No one has had wider experience here than himself, and few, if any, as much. There are many points in favor of his method of aspiration and giving emetine, after the abscess has formed, and there is no doubt but that this treatment may at times be preferable to the open operation and drainage. The objection to this latter is in the former high mortality rate, but today in the hands of skilled surgeons and in proper surroundings this rate is relatively low, and there is unquestioned advantage in the information gained by the open operation, as used by Dr. A. B. Herrick throughout the construction days of the Panama Canal, and at present.

The present evidence does not show much, if any advantage in the serum or vaccine treatment of the bacillary dysenteries. The purgative treatment maintains its position, salines being preferred by some, and castor oil by others. The flagellate diarrheas are mentioned and the author, like the great majority of tropical workers, is not convinced of their specificity. It is peculiar that those who are so convinced base their conclusions on work done in temperate climates.

American leishmaniasis or Espundia is mentioned briefly, mostly the oropharyngeal type. In Brazil, however, 90 per cent of the cases resemble oriental sore. Several forms of treatment are recommended the principal ones being with tartar emetic, and emetine and carbon-dioxide snow locally.

In ankylostomiasis thymol, beta-naphthol, oil of chenopodium and carbon tetra-chloride are stated to be of equal value.

The value of alkaline saline infusion in cholera is clearly shown.

Sir Leonard has written throughout impartially. It would be impossible for one of his wide and varied experience to collect the data without giving his own opinions as well, and these add greatly to the value of the book. We are promised new editions as required by the future progress of Tropical Medicine, and these will be looked forward to as the authoritative opinion of the qualified and efficient expert.

W. M. JAMES.

*Panama City, R. P.*

#### BRIEF REVIEW OF THE "IMMUNOLOGY OF PARASITIC INFECTIONS" BY WILLIAM H. TALIAFERRO, Ph. D.

Although the study of immunology in relation to parasitic infections has only been developed within recent years, yet the publications on this subject have assumed extensive proportions. Professor Taliaferro has gathered together the mass of information now available and analyzed it critically.



A brief account of animal parasitism is followed by an explanation of the cause of infections and the importance of the incubation period in relation to immunological work. A description of the modern concept of immunity follows and the author then summarizes the various immunological reactions which form the basis of the work. Protozoal, helminthic and insect infections are studied and criticised. Chapters III, IV and V are devoted to a careful analysis of the work done in trypanosomiasis, malaria, amoebiasis, leishmaniasis, schistosomiasis, hydatid and trichiniasis infections.

As causes of toxic manifestations the author considers true toxins, endotoxins and proteins or protein products which, though little toxic in a normal host, become markedly so to one sensitized by infection. In the chapters "The Cellular Basis of Immunity," "Local Defense" and "General Defense," reactions are discussed as well as the rôle of eosinophilia and the reticulo endothelial system in parasitic infections. The remaining chapters are devoted to immunity in parasitic infections and the evidence in regard to serological and immunological reactions in the classification of parasites. In writing this book, the author's intention was to bring together the important work done on the subject and to evaluate the results. In this he seems to have been successful and his learned discussion should be of value to other workers in this difficult subject. An extensive reference list of contributions to the subject of the immunology of parasitic infections enhances the importance of this work.

F. W. O'CONNOR.

*New York, N. Y., U. S. A.*

BRIEF REVIEW OF "ANIMAL PARASITOLOGY," BY ROBERT HEGNER, Ph.D., FRANCIS M. ROOT, Ph.D., and DONALD L. AUGUSTINE, Sc.D.

Of recent years the student of medical parasitology has had placed at his disposal good monographs on protozoology, helminthology and entomology. Some of these, such as Wenyon's monumental work on protozoology, Faust's work on helminthology and Alcock's Entomology for Medical Officers, to mention only a few, constitute very complete reference books on each subject. In the work under consideration the writers have successfully placed under one cover a comprehensive account of the three subjects.

The introduction by the senior author gives a general description of parasitism including the differentiation of types of parasitism and he lays special stress on host parasite specificity and relations. This chapter ends with a short but clear exposition of the rules of nomenclature. In the three sections on protozoology, helminthology and entomology the plan has been the same. The parasites in general, with their biology, are described and then classified. While most of

those found in man receive consideration, no space is wasted on those of mainly academic interest. On the other hand, the morphology of the more important parasites is discussed in full detail and this is enhanced by up-to-date information on prophylaxis and prevention. In the account of those parasites which are direct causes of disease the most modern methods of treatment are discussed.

In each section practical advice is given on the best methods for preparing and preserving specimens for immediate and later study. The work is generously illustrated with many clear and descriptive drawings and photographs. The book concludes with fifty-seven pages of bibliography of the most important books and monographs together with a list of journals in frequent usage by parasitologists.

While this work should be of interest to parasitologists in general, it seems to have been written with special consideration for the needs of medical men and veterinarians. It should be of much service to all students of the subject and for practitioners whose work demands a knowledge of parasitology in general.

F. W. O'CONNOR.

*New York, N. Y., U. S. A.*





# SECTION VI

## ORGANIZATION AND VITAL STATISTICS

### SCOPE OF MEDICAL DEPARTMENT

*Phases of the Work.*—The Medical Department functions with respect to all conditions pertaining to the prevention of disease and the care of the sick and injured. This work embraces the following phases:

- (a) In the Tropics, care of employees and their dependents; and of the inhabitants of communities within the limits of, or contiguous to, the plantations when no other medical service is available.
- (b) On all the Company's steamships, care of passengers and members of the crews.
- (c) In the Domestic Divisions where the Company maintains medical staffs, dispensary service to employees.
- (d) Physical examination of prospective salaried employees, and of all steamship crews before they leave the home port, each voyage.
- (e) Supervision of all matters concerning quarantine and immigration affecting the Company's interests.
- (f) In the Tropical Divisions, supervision and recommendation in all matters pertaining to sanitation.
- (g) Sanitation of the Company's steamships.

For the effective performance of these many and varied duties, the Company maintains fully equipped hospitals and dispensaries in the Tropical Divisions, and dispensary service with sanitary staffs in the ports of New York, Boston, and New Orleans.

### PERSONNEL OF THE MEDICAL DEPARTMENT

Name	Title	Graduate of
W. E. Deeks, M.D., A.M.	General Manager, New York, N. Y.	McGill University Faculty of Medicine, Montreal, Quebec, Canada
R. C. Connor, M.D.	Assistant General Manager, New York, N. Y.	University of Texas School of Medicine, Galveston, Texas
J. S. Cudlipp	Assistant to General Manager, New York, N. Y.	
J. R. Ariza, M.D.	Consultant to the Cuban Divisions, Banes, Cuba	Havana University, Havana, Cuba
A. Castellani, M.D., C.M.G., F.R.C.P.	Consultant in Tropical Dermatology, London	Royal University of Florence Faculty of Medicine and Surgery, Italy University of Bonn Faculty of Medicine, Germany
H. C. Clark, M.D.	Consultant in Preventive Medicine, Tropical Pathology, and Laboratory Work, Panama, R. de P.	University of Pennsylvania School of Medicine, Philadelphia, Pa.
W. M. James, M.D.	Consultant in Tropical Medicine, Panama, R. de P.	University of Virginia Department of Medicine, Charlottesville, Va.

Name	Title	Graduate of
F. B. Mallory, M.D., A.B., A.M.	Consulting Pathologist, Boston, Mass.	Harvard University Medical School, Boston, Mass.
R. P. Strong, M.D.	Consultant in Laboratory and Medical Research Work, Boston, Mass.	Harvard University Medical School, Boston, Mass.
P. F. Murphy, M.D.	Port Medical Officer, New Orleans, La.	Tulane University of Louisiana School of Medicine, New Orleans, La.
L. R. Shearin, M.D.	Assistant to Port Medical Officer, New Orleans, La.	University of Tennessee College of Medicine, Memphis, Tenn.
J. M. Lawler, M.D.	Port Medical Officer, New York, N. Y.	Vanderbilt University School of Medi- cine, Nashville, Tenn.
J. A. Gatlin, M.D.	Sanitary Inspector, New York, N. Y.	Memphis Hospital Medical College, Mem- phis, Tenn.
F. X. Crawford, M.D.	Port Medical Officer, Boston, Mass.	Harvard University Medical School, Boston, Mass.
Harry Eno, M.D.	District Medical Officer, Cristobal, C. Z. (Samaritan Hospital)	Cornell University Medical College, New York, N. Y.
J. A. Corrigan	General Sanitary Inspector, Cristobal, C. Z.	
Carleton Hale	General Sanitary Inspector, New York, N. Y.	

## BANES DIVISION

Name	Title	Graduate of
P. S. Malaret, M.D.	Assistant Superintendent Cuban Divisions	University of Pennsylvania School of Medicine, Philadelphia, Pa. (Medico- Chirurgical College)
A. F. Ruiz, M.D.	Assistant Surgeon	Universidad de la Habana Facultad de Medicina, Cuba
R. A. Hernandez, M.D.	Physician	Indiana University School of Medicine, Indianapolis, Ind.
V. Bustillo, M.D.	Physician	Loyola University School of Medicine, Chicago, Ill.
T. de la Torre, M.D.	District Medical Officer	University of Maryland School of Medi- cine, Baltimore, Md.
Catharin Cotter, R. N.	Matron	Kings County Hospital School of Nursing, Brooklyn, N. Y.
Lillian Dixon, R. N.	Nurse	Hamilton General Hospital, Hamilton Ontario, Canada
Marie K. Falconer, R. N.	Nurse	New York Hospital School of Nursing, New York, N. Y.
Francisca Archer, R. N.	Nurse	Public General Hospital, Kingston, Jamaica
Mabel Heron, R. N.	Nurse	Public General Hospital, Kingston, Jamaica
Ivy A. Gayle, R. N.	Nurse	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—63

## CHIRIQUI LAND COMPANY

Name	Title	Graduate of
O. T. Brosius, M.D., D.T.M. and H., F.A.C.P.	Superintendent	Tufts College Medical School, Boston, Mass.
K. P. A. Taylor, M.D., F.A.C.S., B.S.	Surgeon	London School of Tropical Medicine, London, England
J. R. Maltsberger, B. A.	Laboratory Technician and Chief Sanitary Inspector	University of Pennsylvania School of Medicine, Philadelphia, Pa.
Helen Flanagan, R. N.	Matron	State University of Iowa, Iowa City, Iowa.
		Naval Laboratory School Massachusetts General Hospital School of Nursing, Boston, Mass.

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—22

COLOMBIA DIVISION

Name	Title	Graduate of
L. M. Drennan, M.D.	Superintendent	Georgetown University School of Medicine, Washington, D. C.
E. Thonnard-Neumann, M.D.	Physician and Assistant to Superintendent	University of Frankfurt-am-Main, Faculty of Medicine, Frankfurt, Germany
J. Camacho, M.D.	Physician	Universidad de Valencia Facultad de Medicina, Spain
M. E. Duran, M.D.	Physician	Northwestern University Medical School, Chicago, Ill.
O. Tatis, M.D.	District Medical Officer	Universidad de Bolivar, Cartagena, Colombia
J. E. Llinas, M.D.	District Medical Officer	Universidad Nacional Facultad de Medicinas, Bogota, Colombia
J. A. Fontalvo, M.D.	District Medical Officer	Universidad de Bolivar, Cartagena, Colombia
K. C. Brewster, B.S.	Laboratory Technician	New Mexico College of Agric. and Mech., N. M.
Martha W. Vessels, R.N.	Matron	Capital City School of Nursing, Washington, D. C.
Nellie M. Ross, R.N.	Nurse	Norfolk Protestant Hospital School of Nursing, Norfolk, Va.
Esther C. Severson, R.N.	Nurse	Hurley Hospital School of Nursing, Flint, Mich.
Doris, Melville, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Mabel M. Willis, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Ruby A. Fray, R. N.	Nurse	Nuttall's Nursing Home, Crossroads, Jamaica
Lee W. Cahusac, R. N.	Nurse	Nuttall's Nursing Home, Crossroads, Jamaica
Gertrude E. Dunning, R.N.	Nurse	Bristol Royal Infirmary, Bristol, England
Lilian H. Marshall, R.N.	Nurse	Nuttall's Nursing Home, Crossroads and Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—95

COSTA RICA DIVISION

Name	Title	Graduate of
E. I. Salisbury, M.D., F.A.C.S.	Superintendent	Jefferson Medical College of Philadelphia, Philadelphia, Pa.
M.D. Rojas, M.D., Ph.C.	Assistant Surgeon	Tulane University of Louisiana School of Medicine, New Orleans, La.
A. A. Facio, M.D., F.A.C.S.	District Medical Officer	University of Pennsylvania School of Medicine, Philadelphia, Pa. (Medico-Chirurgical College)
C. M. Jimenez, M.D.	Physician	University of Brussels Faculty of Medicine, Belgium
A. Lachner Chacon, M.D.	Physician	University of Munchen Faculty of Medicine, Munich, Germany
Mary C. Walsh, R.N.	Matron	St. Joseph's Hospital School of Nursing, St. Paul, Minn.
Agnes K. Donegan, R.N.	Nurse	Victoria Hospital, Yorkshire, England
Melva G. John, A.B., R.N.	Nurse	Denver University, Denver, Colo.
Thea Hoffmann, R.N.	Nurse	St. Mary's Hospital School of Nursing, Rochester, Minn.
Kathryn C. Sweeney, R.N.	Nurse	Koblenberg Stift Maydeburg, Germany
Sibyl E. Chaplin, R.N.	Nurse	St. Joseph's School of Nursing, St. Paul, Minn.
Josephine W. Shrine, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
		Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—96



## GUATEMALA DIVISION

Name	Title	Graduate of
N. P. Macphail, M.D.	Superintendent	University of Aberdeen Faculty of Medicine, Scotland
R. Aguilar, M.D., D.D.S.	Surgeon	Universidad Central Facultad de Medicina y Cirugia, Tegucigalpa, Honduras Strycher Dental School, New York, N. Y.
C. M. Roberts, M.D., B.S.	Assistant Physician	Northwestern University Medical School, Chicago, Ill.
G. R. Harrod, M.D.	Assistant Physician	University of Louisville School of Medicine, Louisville, Ky.
L. R. Mathews	Laboratory Technician	
Myra Ellerby, R.N.	Matron	Middlesex Hospital, London, England
Johanna M. Brosnan, R.N.	Assistant Matron	Hospital St. John and Elizabeth, London, England
Margaret A. Storrow, R.N.	Nurse	Cumberland Infirmary, Carlisle, England
Nina Pendleton, R.N.	Nurse	Liverpool Royal Infirmary, Liverpool, England
Carmen Mendez, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala
Maria Martinez, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala
Maria Sagastume, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala
Mariana Cordon, R.N.	Nurse	Hospital Americano, Guatemala City, Guatemala

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—100

## JAMAICA DIVISION

Name	Title	Graduate of
I. W. McLean, M.D., F.A.C.S.	Superintendent	University of Maryland School of Medicine, Baltimore, Md.
J. G. Moseley, M.D., B.S., M.R.C.S., L.R.C.P.	District Physician	University of London Faculty of Medicine, England
C. A. Moseley, M.D.	District Physician	University College Hospital Medical School, London, England
F. R. Evans, M.D.	District Physician	Bellevue Hospital Medical College, New York, N. Y.
A. C. Lushington, M.D., C.M., L.R.C.P., L.R.-C.S., L.F.P. and S.	District Physician	University of Edinburgh Faculty of Medicine, Edinburgh, Scotland University of Glasgow Medical Faculty, Glasgow, Scotland
L. B. Lyon, M.B., M.C.P. and S.	District Physician	University of Toronto Faculty of Medicine, Ontario, Canada

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—21

## PANAMA DIVISION

Name	Title	Graduate of
H. M. Walker, M.D., A.B.	Acting Superintendent	University of Texas School of Medicine, Galveston, Texas
W. S. Dove, M.D., A.B.	Surgeon	University of Texas School of Medicine, Galveston, Texas
Mae A. Kenney, R.N.	Matron	Worcester City Hospital School of Nursing, Worcester, Mass.
Clara Totzke, G.N.	Nurse	Hamburg-Eppendorf, Hamburg, Germany

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—42

PRESTON DIVISION

Name	Title	Graduate of
J. de la Guardia, M.D.	Superintendent Cuban Divisions	Jefferson Medical College of Philadelphia, Philadelphia, Pa.
O. Ortiz, M.D.	Assistant Surgeon	Universidad de la Habana Facultad de Medicina, Cuba
C. Castellanos, M.D.	Physician	Tulane University of Louisiana School of Medicine, New Orleans, La.
J. de los Reyes, M.D.	Physician	Jefferson Medical College of Philadelphia, Philadelphia, Pa.
W. Cordes, M.D.	Bacteriologist and Roentgenologist	Marburg University Medical Faculty, Germany
Matilda L. Baiz, R.N.	Matron	New York Post-Graduate Medical School and Hospital School of Nursing, New York, N. Y.
Anita Gonzalez, R.N.	Nurse	Robert B. Green Memorial Hospital School of Nursing, San Antonio, Texas
Margaret Beckman, R.N.	Nurse	St. Joseph's Hospital School of Nursing, St. Paul, Minn.
Florence Ehrentraut, R.N.	Nurse	Latrobe Hospital School of Nursing, Latrobe, Pa.
Margarita Hernandez, R.N.	Nurse	Santo Tomas Hospital Training School, Panama City, Panama
Helen Greenlees, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Bernella Mattis, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Lena Biggs, R.N.	Nurse	Public General Hospital, Kingston, Jamaica
Catherine Clarke, R.N.	Nurse	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—56

TELA RAILROAD COMPANY

Name	Title	Graduate of
R. B. Nutter, M.D.	Superintendent	Tufts College Medical School, Boston, Mass.
E. J. Whitaker, M.D.	Physician	State University of Iowa College of Medicine, Iowa City, Iowa
A. E. Moure, M.D.	Physician	Sorbonne Medical School, Paris, France
G. Izaguirre, M.D.	Physician	Syracuse University College of Medicine, Syracuse, N. Y.
J. C. McDaniel	Bacteriologist	
Betty Tomeny, R.N.	Matron	Charity Hospital School of Nursing, New Orleans, La.
Hildegard Hartman, R.N.	Nurse	Schassburg Hospital, Siebengurgen, Germany
Lila Maud Peart, G.N.	Nurse	Public General Hospital, Kingston, Jamaica

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—73

TRUXILLO RAILROAD COMPANY

Name	Title	Graduate of
B. M. Phelps, M.D.	Superintendent	Vanderbilt University School of Medicine, Nashville, Tenn.
L. R. Fletcher, M.D., A.B.	Assistant Surgeon	Rush Medical College (University of Chicago), Chicago, Ill.
W. Jantzen, M.D.	Physician and Bacteriologist	University of Kiel Faculty of Medicine, Germany
J. A. Lopez, M.D.	Physician	George Washington University Medical School, Washington, D. C.
Gena H. Robertson, R.N.	Matron	Sarah Leigh Hospital School of Nursing, Norfolk, Va.
America Ferrera, G.N.	Nurse	D'Antoni Hospital, La Ceiba, Honduras
Sylvia Haylock, G.N.	Nurse	D'Antoni Hospital, La Ceiba, Honduras

TOTAL NUMBER OF EMPLOYEES, OTHER THAN DOCTORS, REGISTERED NURSES, AND LABORATORY TECHNICIANS—81

## SUMMARY OF WORK DONE

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	M.	F.	M.	F.	M.	F.	M.	F.
PERSONS DEPENDENT UPON THE MEDICAL DEPARTMENT FOR TREATMENT:								
Employees:								
From Temperate Zone . . . . .	338	13	175	3	126	10	217	
Others . . . . .	6,248	107	3,340	58	6,755	285	5,745	
Non-employees:								
From Temperate Zone . . . . .	1,038	613	13	15	459	199	77	
Others . . . . .	12,846	15,981	224	498	6,526	6,913	3,400	4
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees . . . . .	351	6,355	178	3,398	136	7,040	237	6
Non-employees . . . . .	1,651	28,827	28	722	658	13,439	190	7
TOTAL . . . . .	2,002	35,182	206	4,120	794	20,479	427	13
Passengers on steamships . . . . .	-	-	-	-	-	-	-	-
Officers, crews and ships' laborers. . . . .	-	-	-	-	-	-	-	-
TOTAL . . . . .	-	-	-	-	-	-	-	-
GRAND TOTAL . . . . .	-	-	-	-	-	-	-	-
PATIENTS TREATED IN HOSPITALS:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone . . . . .	104	2	252	2	153	3	131	
Others . . . . .	1,236	8	742	15	3,641*	124	2,367	
Non-employees:								
From Temperate Zone . . . . .	16	19	7	2	49	25	61	
Others . . . . .	155	390	40	147	304	366	703	
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees . . . . .	106	1,244	254	757	156	3,765	134	2
Non-employees . . . . .	35	545	9	187	74	670	72	1
GRAND TOTAL . . . . .	141	1,789	263	944	230	4,435	206	3
TREATMENTS IN HOSPITAL DISPENSARIES:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone . . . . .	1,234	41	3,565	130	231	-	613	
Others . . . . .	17,956	328	17,284	1,084	23,690	684	9,758	
Non-employees:								
From Temperate Zone . . . . .	261	386	205	296	116	90	111	
Others . . . . .	7,523	11,835	3,862	6,553	1,094	2,522	899	1
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees . . . . .	1,275	18,284	3,695	18,368	231	24,374	623	10
Non-employees . . . . .	647	19,358	501	10,415	206	3,616	205	2
GRAND TOTAL . . . . .	1,922	37,642	4,196	28,783	437	27,990	828	12
TREATMENTS IN FIELD DISPENSARIES:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone . . . . .	-	-	1,427	6	163	-	142	
Others . . . . .	-	-	20,417	362	29,570	1,346	15,130	
Non-employees:								
From Temperate Zone . . . . .	-	-	5	18	-	-	2	
Others . . . . .	-	-	873	2,743	7	44	260	1
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees . . . . .	-	-	1,433	20,779	163	30,916	142	15
Non-employees . . . . .	-	-	23	3,616	-	51	4	1
GRAND TOTAL . . . . .	-	-	1,456	24,395	163	30,967	146	17

\* Including 4 patients treated in Aracataca Line Hospital.



## AND VITAL STATISTICS

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
188	10	114	4	87	5	245	14	314	10	238	9	2,042	98	2,140
3,395	127	15,088	3,577	2,212	247	7,295	114	6,743	127	4,936	134	61,757	5,068	66,825
270	240	51	74	4	29	195	136	54	115	36	66	2,197	1,600	3,797
1,872	5,430	7,553	11,324	1,187	1,618	3,526	5,263	827	1,579	809	1,766	43,770	54,689	98,459
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
198	3,522	118	18,665	92	2,459	259	7,409	324	6,870	247	5,070	2,140	66,825	68,965
510	12,302	125	18,877	33	2,805	331	8,789	169	2,406	102	2,575	3,797	98,459	102,256
708	15,824	243	37,542	125	5,264	590	16,198	493	9,276	349	7,645	5,937	165,284	171,221
-	-	-	-	-	-	-	-	-	-	-	-	-	-	56,603
-	-	-	-	-	-	-	-	-	-	-	-	-	-	30,725
-	-	-	-	-	-	-	-	-	-	-	-	-	-	87,328
-	-	-	-	-	-	-	-	-	-	-	-	-	-	258,549
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
141	6	17	1	71	6	125	4	199	4	175	6	1,368	37	1,405
1,193	66	19	5	935	125	1,389	17	3,247	30	2,722	46	17,491	531	18,022
156	74	11	2	6	23	36	33	98	91	52	20	492	300	792
834	291	1	1	218	398	230	490	329	956	298	727	3,112	4,295	7,407
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
147	1,259	18	24	77	1,060	129	1,406	203	3,277	181	2,768	1,405	18,022	19,427
230	1,125	13	2	29	616	69	720	189	1,285	72	1,025	792	7,407	8,199
377	2,384	31	26	106	1,676	198	2,126	392	4,562	253	3,793	2,197	25,429	27,626
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
738	11	565	28	804	68	1,084	2	1,837	49	1,462	96	12,133	435	12,568
2,873	166	6,745	1,535	7,713	1,629	10,481	252	13,235	135	6,649	289	116,384	6,447	122,831
211	193	404	168	64	420	148	252	376	1,434	402	298	2,298	3,631	5,929
692	435	1,791	1,461	1,787	4,241	3,625	5,884	1,512	4,450	1,259	3,003	24,044	41,867	65,911
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
749	3,039	593	8,280	872	9,342	1,086	10,733	1,886	13,370	1,558	6,938	12,568	122,831	135,399
404	1,127	572	3,252	484	6,028	400	9,509	1,810	5,962	700	4,262	5,929	65,911	71,840
1,153	4,166	1,165	11,532	1,356	15,370	1,483	20,242	3,696	19,332	2,258	11,200	18,497	188,742	207,239
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
934	71	331	-	129	2	-	-	611	-	97	-	3,834	79	3,913
1,647	393	12,707	4,002	8,355	1,555	-	-	21,323	60	8,047	49	127,196	8,488	135,684
319	168	-	11	8	11	-	-	3	13	-	-	337	223	560
1,128	883	782	863	714	1,910	-	-	379	994	186	483	4,329	8,935	13,264
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
1,005	12,040	331	16,709	131	9,910	-	-	611	21,383	97	8,096	3,913	135,684	139,597
487	2,011	11	1,645	19	2,624	-	-	16	1,373	-	669	560	13,264	13,824
1,492	14,051	342	18,354	150	12,534	-	-	627	22,756	97	8,765	4,473	148,948	153,421

## SUMMARY OF WORK DONE

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	M.	F.	M.	F.	M.	F.	M.	F.
TOTAL NUMBER OF TREATMENTS IN HOSPITAL AND FIELD DISPENSARIES:								
Employees:								
From Temperate Zone . . . . .	1,234	41	4,992	136	394	-	755	
Others . . . . .	17,956	328	37,701	1,446	53,260	2,030	24,888	1,0
Non-employees:								
From Temperate Zone . . . . .	261	386	210	314	116	90	113	
Others . . . . .	7,523	11,835	4,735	9,296	1,101	2,566	1,159	2,4
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees . . . . .	1,275	18,284	5,128	39,147	394	55,290	765	25,9
Non-employees . . . . .	647	19,358	524	14,031	206	3,667	209	3,6
GRAND TOTAL . . . . .	1,922	37,642	5,652	53,178	600	58,957	974	29,6
NUMBER OF HOSPITAL DAYS:								
Employees:	M.	F.	M.	F.	M.	F.	M.	F.
From Temperate Zone . . . . .	1,046	15	1,397	11	1,328	10	1,631	
Others . . . . .	16,272	50	7,315	112	46,556*	1,295	39,259	1,3
Non-employees:								
From Temperate Zone . . . . .	100	121	43	15	1,023	302	1,626	1
Others . . . . .	1,667	3,160	342	1,147	4,624	4,186	11,592	7,0
Totals:	T.	O.	T.	O.	T.	O.	T.	O.
Employees . . . . .	1,061	16,322	1,408	7,427	1,338	47,851	1,644	40,5
Non-employees . . . . .	221	4,827	58	1,489	1,325	8,810	1,735	18,6
GRAND TOTAL . . . . .	1,282	21,149	1,466	8,916	2,663	56,661	3,379	59,2
NUMBER OF TREATMENTS ABOARD PASSENGER STEAM-SHIPS. . . . .	-	-	-	-	-	-	-	-
NUMBER OF TREATMENTS BY PORT MEDICAL OFFICERS . . . . .	-	-	-	-	-	-	-	-
NUMBER OF SEAMEN AND APPLICANTS EXAMINED BY PORT MEDICAL OFFICERS . . . . .	-	-	-	-	-	-	-	-
DEATHS, HOSPITALS:								
Employees:								
From Temperate Zone . . . . .	1		1		-		3	
Others . . . . .	25		24		48		64	
Non-employees:								
From Temperate Zone . . . . .	2		1		2		2	
Others . . . . .	30		9		28		91	
Totals:								
Employees . . . . .	26		25		48		67	
Non-employees . . . . .	32		10		30		93	
GRAND TOTAL . . . . .	58		35		78		160	
DEATHS, HOSPITAL DISPENSARIES:								
Employees:								
From Temperate Zone . . . . .	1		-		-		-	
Others . . . . .	6		-		3		6	
Non-employees:								
From Temperate Zone . . . . .	-		1		-		-	
Others . . . . .	33		-		4		15	
Totals:								
Employees . . . . .	7		-		3		6	
Non-employees . . . . .	33		1		4		15	
GRAND TOTAL . . . . .	40		1		7		21	

\* Including 12 days in Aracataca Line Hospital.

† Including 2,405 days in Bananera and Entre Rios Sick Camps.

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1,672	82	896	28	933	70	1,084	2	2,448	49	1,559	96	15,967	514	16,481
14,520	559	19,452	5,537	16,068	3,184	10,481	252	34,558	195	14,696	338	243,580	14,935	258,515
530	361	404	179	72	431	148	252	379	1,447	402	298	2,635	3,854	6,489
1,820	1,318	2,573	2,324	2,501	6,151	3,625	5,884	1,891	5,444	1,445	3,486	28,373	50,802	79,175
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
1,754	15,079	924	24,989	1,003	19,252	1,086	10,733	2,497	34,753	1,655	15,034	16,481	258,515	274,996
891	3,138	583	4,897	503	8,652	400	9,509	1,826	7,335	700	4,931	6,489	79,175	85,664
2,645	18,217	1,507	29,886	1,506	27,904	1,486	20,242	4,323	42,088	2,355	19,965	22,970	337,690	360,660
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1,448	61	182	19	618	65	1,413	57	2,186	49	2,115	45	13,364	345	13,709
14,550†	922	271	117	13,394	1,841	19,661	108	45,997	212	32,876	1,079	236,151	7,048	243,199
2,218	851	138	19	65	187	534	429	1,073	766	1,068	380	7,888	3,179	11,067
8,984	2,349	8	21	2,608	3,851	2,661	4,699	3,601	6,005	4,239	6,576	40,326	39,042	79,368
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
1,509	15,472	201	388	683	15,235	1,470	19,769	2,235	46,209	2,160	33,955	13,709	243,199	256,908
3,069	11,333	157	29	252	6,459	963	7,360	1,839	9,606	1,448	10,815	11,067	79,368	90,435
4,578	26,805	358	417	935	21,694	2,433	27,129	4,074	55,815	3,608	44,770	24,776	322,567	347,343
-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,243
-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,432
-	-	-	-	-	-	-	-	-	-	-	-	-	-	28,896
2		-		1		3		1		-				12
49		1		28		49		43		63				394
4		1		-		1		5		7				25
51		-		34		36		46		41				366
51		1		29		52		44		63				406
55		1		34		37		51		48				391
106		2		63		89		95		111				797
-		1		-		1		-		-				3
-		8		1		3		-		-				27
-		-		-		3		-		-				4
-		1		2		94		-		-				149
-		9		1		4		-		-				30
-		1		2		97		-		-				153
-		10		3		101		-		-				183



## SUMMARY OF WORK DONE

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	M.	F.	M.	F.	M.	F.	M.	F.
*DEATHS, FIELD DISPENSARIES:								
Employees:								
From Temperate Zone . . . . .	—	—	—	—	—	—	—	2
Others . . . . .	—	—	1	—	1	—	—	13
Non-employees:								
From Temperate Zone . . . . .	—	—	—	—	—	—	—	—
Others . . . . .	—	—	6	—	—	—	—	4
Totals:								
Employees . . . . .	—	—	1	—	1	—	—	15
Non-employees . . . . .	—	—	6	—	—	—	—	4
GRAND TOTAL . . . . .	—	—	7	—	1	—	—	19
DEATHS, HOSPITALS AND ALL DISPENSARIES COMBINED:								
Employees:								
From Temperate Zone . . . . .	2	—	1	—	—	—	—	5
Others . . . . .	31	—	25	—	52	—	—	83
Non-employees:								
From Temperate Zone . . . . .	2	—	2	—	2	—	—	2
Others . . . . .	63	—	15	—	32	—	—	110
Totals:								
Employees . . . . .	33	—	26	—	52	—	—	88
Non-employees . . . . .	65	—	17	—	34	—	—	112
GRAND TOTAL . . . . .	98	—	43	—	86	—	—	200
DEATHS, STEAMSHIP SERVICE:								
Passengers . . . . .	—	—	—	—	—	—	—	—
Officers, crews and ships' laborers . . . . .	—	—	—	—	—	—	—	—
TOTAL . . . . .	—	—	—	—	—	—	—	—
GRAND TOTAL—DEATHS AMONG PERSONS DEPENDENT ON THE COMPANY FOR TREATMENT: (Steamship service included). . . . .								
	—	—	—	—	—	—	—	—
REPATRIATIONS:								
Employees:								
From Temperate Zone . . . . .	—	—	—	—	1	—	—	—
Others . . . . .	1	—	2	—	53	—	—	1
Non-employees:								
From Temperate Zone . . . . .	—	—	—	—	—	—	—	—
Others . . . . .	—	—	—	—	—	—	—	—
Totals:								
Employees . . . . .	1	—	2	—	54	—	—	1
Non-employees . . . . .	—	—	—	—	—	—	—	—
GRAND TOTAL . . . . .	1	—	2	—	54	—	—	1
AVERAGE DAILY NUMBER OF PATIENTS IN HOSPITALS:								
Employees:								
From Temperate Zone . . . . .	2.91	—	3.87	—	3.68	—	—	4.52
Others . . . . .	44.84	—	20.40	—	131.45	—	—	111.45
Non-employees:								
From Temperate Zone . . . . .	.61	—	.16	—	3.64	—	—	4.77
Others . . . . .	13.26	—	4.09	—	24.20	—	—	51.21
Totals:								
Employees . . . . .	47.75	—	24.27	—	135.13	—	—	115.97
Non-employees . . . . .	13.87	—	4.25	—	27.84	—	—	55.98
GRAND TOTAL . . . . .	61.62	—	28.52	—	162.97	—	—	171.95

\* Including "Other Deaths"—See appendix of table on pages 378-379.



## SUMMARY OF WORK DONE

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	M.	F.	M.	F.	M.	F.	M.	F.
AVERAGE DAILY NUMBER OF TREATMENTS IN HOSPITAL DISPENSARIES AND FIELD DISPENSARIES:								
Employees:								
From Temperate Zone . . . . .		3.50		14.09		1.08		2.10
Others . . . . .		50.23		107.54		151.90		71.30
Non-employees:								
From Temperate Zone . . . . .		1.78		1.44		.57		.57
Others . . . . .		53.18		38.55		10.07		10.05
Totals:								
Employees . . . . .		53.73		121.63		152.98		73.40
Non-employees . . . . .		54.96		39.99		10.64		10.62
GRAND TOTAL . . . . .		108.69		161.62		163.62		84.02
DEATH RATE PER THOUSAND PERSONS DEPENDENT ON THE COMPANY FOR TREATMENT (Steamship ser- vice not included):								
Employees:								
From Temperate Zone . . . . .		5.70		5.62		—		21.10
Others . . . . .		4.88		7.36		7.39		13.75
Non-employees:								
From Temperate Zone . . . . .		1.21		71.43		3.04		10.53
Others . . . . .		2.19		20.78		2.38		14.25
Totals:								
Employees . . . . .		4.92		7.27		7.25		14.03
Non-employees . . . . .		2.13		22.67		2.41		14.16
GRAND TOTAL . . . . .		2.64		9.93		4.04		14.10
AVERAGE NUMBER OF HOSPITAL DAYS ANNUALLY, PER EMPLOYEE:								
From Temperate Zone . . . . .		3.02		7.91		9.84		6.94
Others . . . . .		2.57		2.19		6.80		6.72
TOTAL . . . . .		2.59		2.47		6.85		6.73
HOSPITAL ADMISSION RATE ANNUALLY, PER THOUSAND EMPLOYEES:								
From Temperate Zone . . . . .		302		1,427		1,147		565
Others . . . . .		196		223		535		408
TOTAL . . . . .		201		283		546		414
AVERAGE NUMBER DISPENSARY TREATMENTS ANNUALLY, PER EMPLOYEE:								
From Temperate Zone . . . . .		3.63		28.81		2.90		3.23
Others . . . . .		2.88		11.52		7.85		4.30
TOTAL . . . . .		2.92		12.38		7.76		4.26
AVERAGE NUMBER OF EMPLOYEES NON-EFFECTIVE, PER THOUSAND EMPLOYEES:								
From Temperate Zone . . . . .		8.29		21.74		27.08		19.07
Others . . . . .		7.06		6.00		18.67		18.46
TOTAL . . . . .		7.12		6.79		18.83		18.48
AVERAGE NUMBER OF EMPLOYEES PARTIALLY NON- EFFECTIVE PER THOUSAND EMPLOYEES:								
From Temperate Zone . . . . .		9.97		79.16		7.94		8.86
Others . . . . .		7.90		31.65		21.58		11.81
TOTAL . . . . .		8.01		34.01		21.32		11.70



AND VITAL STATISTICS—*Concluded*

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Total, Excluding Jamaica Division		Total
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
4.82		2.54		2.76		2.98		6.86		4.55		42.74		45.28
41.42		68.65		52.89		29.49		95.47		41.30		641.55		710.20
2.45		1.60		1.38		1.10		5.02		1.92		16.23		17.83
8.62		13.45		23.77		26.12		20.15		13.55		204.06		217.51
46.24		71.19		55.65		32.47		102.33		45.85		684.29		755.48
11.07		15.05		25.15		27.22		25.17		15.47		220.29		235.34
57.31		86.24		80.80		59.69		127.50		61.82		904.58		990.82
10.10		8.47		10.87		15.44		3.09		—		7.91		7.94
13.91		.80		13.83		7.96		6.84		15.78		9.55		7.11
7.84		8.00		30.30		12.08		29.59		63.63		7.90		7.90
4.63		.16		13.19		18.20		20.78		18.64		7.19		5.84
13.71		.85		13.72		8.22		6.67		15.05		9.49		7.13
4.76		.21		13.39		17.98		21.36		20.55		7.22		5.92
6.77		.53		13.55		13.52		10.54		16.89		8.07		6.41
7.62		1.70		7.42		5.68		6.90		8.74		6.68		6.41
4.39		.02		6.20		2.67		6.73		6.70		5.04		3.64
4.56		.03		6.24		2.77		6.73		6.79		5.11		3.73
742		153		837		498		627		733		686		656
357		1		431		190		477		546		374		270
378		2		446		200		484		555		386		282
8.86		7.83		10.90		4.19		7.71		6.70		7.69		7.70
4.28		1.34		7.83		1.45		5.06		2.97		4.85		3.87
4.53		1.38		7.94		1.54		5.18		3.14		4.96		3.99
20.91		4.66		20.43		15.60		18.95		24.01		18.35		17.60
12.07		.06		17.02		7.33		18.48		18.40		13.85		10.00
12.54		.09		17.14		7.61		18.50		18.66		14.03		10.23
24.34		21.53		30.00		11.51		21.17		18.42		21.14		21.16
11.76		3.68		21.51		3.98		13.90		8.15		13.32		10.63
12.43		3.79		21.81		4.23		14.22		8.62		13.64		10.95

## RECORD OF

			Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
			T.	O.	T.	O.	T.	O.	T.	O.
Remaining from last year . . . . .	{	Emp. { M. F. Non-emp. { M. F.	1 — — —	30 — 3 3	4 — — —	9 — — 1	3 — — 1	76 — 8 4	2 — 5 1	9 — 3 1
Admitted this year . . . . .	{	Emp. { M. F. Non-emp. { M. F.	103 2 16 19	1,206 8 152 387	248 2 7 2	733 15 40 146	150 3 49 24	3,561 124 296 362	129 3 56 10	2,279 9 67 51
Discharged . . . . .	{	Emp. { M. F. Non-emp. { M. F.	103 2 15 19	1,216 8 150 380	247 2 7 2	721 15 40 145	150 3 46 25	3,526 120 286 356	130 3 59 10	2,299 9 68 51
Remaining . . . . .	{	Emp. { M. F. Non-emp. { M. F.	1 — 1 —	20 — 5 10	5 — — —	21 — — 2	3 — 3 —	111 4 18 10	1 — 2 1	7 — 2 1
Died . . . . .	{	Emp. Non-emp.	1 2	25 30	1 1	24 9	— 2	48 28	3 2	6 9
Repatriated . . . . .	{	Emp. Non-emp.	— —	1 —	— —	2 —	1 —	53 —	— —	— —
Total number of hospital days . . . . .	{	Emp. { M. F. Non-emp. { M. F.	1,046 15 100 121	16,272 50 1,667 3,160	1,397 11 43 15	7,315 112 342 1,147	1,328 10 1,023 302	46,544 1,295 4,624 4,186	1,631 13 1,626 109	39,259 1,311 11,597 7,044
Operations with general anesthesia . . . . .	{	Emp. Non-emp.	3 2	51 116	4 1	13 9	1 4	51 69	6 1	7 8
Operations with or without local anesthesia . . . . .	{	Emp. Non-emp.	10 7	572 83	31 3	167 44	7 37	1,445 364	26 122	2,299 90

## HOSPITALS

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-Totals		Total
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
1	30	—	—	1	47	3	39	3	98	7	66	25	490	515
—	5	—	1	—	2	—	—	—	1	—	1	—	13	13
9	30	—	—	—	3	1	2	2	12	8	15	25	104	129
—	7	—	—	—	8	—	9	3	6	2	6	7	57	64
140	1,163	17	19	70	888	122	1,350	196	3,149	168	2,656	1,343	16,997	18,340
6	61	1	4	6	123	4	17	4	29	6	45	37	518	555
147	804	11	1	6	215	35	228	96	317	44	283	467	3,008	3,475
74	284	2	1	23	390	33	481	88	950	18	721	293	4,238	4,531
138	1,144	16	18	71	924	117	1,358	192	3,148	174	2,642	1,338	16,993	18,331
6	62	1	5	6	123	4	16	4	30	6	42	37	514	551
154	811	10	1	5	215	36	223	94	326	48	290	474	3,022	3,496
72	287	2	1	23	392	33	478	90	938	19	717	295	4,212	4,507
3	49	1	1	—	11	8	31	7	99	1	80	30	494	524
—	4	—	—	—	2	—	1	—	—	—	4	—	17	17
2	23	1	—	1	3	—	7	4	3	4	8	18	90	108
2	4	—	—	—	6	—	12	1	18	1	10	5	83	88
2	49	—	1	1	28	3	49	1	43	—	63	12	394	406
4	51	1	—	—	34	1	36	5	46	7	41	25	366	391
—	—	—	—	—	13	—	8	—	10	1	2	2	90	92
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1,448	12,145	182	271	618	13,394	1,413	19,661	2,186	45,997	2,115	32,876	13,364	233,734	247,098
61	922	19	117	65	1,841	57	108	49	212	45	1,079	345	7,048	7,393
2,218	8,984	138	8	65	2,608	534	2,661	1,073	3,601	1,068	4,239	7,888	40,326	48,214
851	2,349	19	21	187	3,851	429	4,699	766	6,005	380	6,576	3,179	39,042	42,221
11	68	—	2	6	68	14	141	6	53	14	106	65	623	688
26	55	—	1	4	68	24	268	20	58	3	48	85	775	860
—	196	1	1	8	631	38	802	51	995	80	892	252	7,991	8,243
12	99	4	—	3	186	24	251	23	411	8	249	243	2,596	2,839



## RECORD OF

		Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division																										
		T.	O.	T.	O.	T.	O.	T.	O.																									
Number of treatments administered . .	{	Emp.	{	M.	1,234	17,956	3,565	17,284	231	23,690	613	9,755																						
					F.	41	328	130	1,084	—	684	10	34																					
						Non-	{	M.	261	7,523	205	3,862	116	1,094	111	89																		
									emp.	{	F.	386	11,835	296	6,553	90	2,522	94	1,481															
{	Emp.	{	M.	103								1,206	197	583	101	1,447	69	1,175																
				Patients sent to hospitals . . . . .	{							F.	2	8	2	11	3	57	3	5														
						Non-	{	M.					16	152	6	38	49	293	55	55														
									emp.	{	F.		18	388	2	126	24	355	7	44														
{	Emp.	{	M.										89	264	2	—	19	128	80	14														
				Visits to lodgings . . . . .	{							F.	4	6	2	—	1	3	—	—														
						Non-	{	M.					35	212	4	—	15	—	—	4														
									emp.	{	F.		61	365	38	8	50	5	1	3														
{	Emp.	{	—										—	—	1	—	—																	
				Operations with general anesthesia . .	{							Non-emp.						{	—	—	—	1	—											
						{	Emp.	{																230	3,290	394	2,200	5	564	79	89			
									Operations with or without local anes-	{	Non-emp.																					{	197	8,962
{	Emp.	{	1										6	—	—	—	3																	
				Died . . . . .	{							Non-emp.						{	—	33	1	—	—											
						{	Emp.	{																—	—	—	—	—	—	—				
									Repatriated . . . . .	{	Non-emp.																				{	—	—	—

## HOSPITAL DISPENSARIES

[illegible]

## RECORD OF

			Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division							
			T.	O.	T.	O.	T.	O.	T.	O.						
Number of treatments administered . .	{	Emp.	{	M.	-	-	1,427	20,417	163	29,570	142	15,130				
					F.	-	-	6	362	-	1,346	-	723			
						Non-	{	M.	-	-	5	873	-	7	2	260
									emp.	{	F.	-	-	18	2,743	-
{	M.	-	-	7,808								12,066	4,781			
		F.	-	-	120							422	198			
			{	Non-	{	M.	-	-				257	1	45		
							emp.	{	F.	-	-	859	9	137		
{	M.									-	-	14,036	17,667	10,491		
		F.								-	-	248	924	523		
			{	Non-	{	M.				-	-	621	6	217		
							emp.	{	F.	-	-	1,902	35	880		
{	M.									-	-	16,807	18,632	12,111		
		F.								-	-	25,851	31,130	17,272		
			{	Emp.	{	M.				-	-	48	244	49	2,114	60
							F.	-	-	-	5	-	67	-	38	
{	Non-							{	M.	-	-	-	4	-	3	1
		emp.								{	F.	-	-	-	46	-
			{	M.	-	-						1,716	514	1,956		
					F.	-	-					101	161	212		
{	Non-					{	M.	-	-			258	15	38		
		emp.						{	F.	-	-	566	44	737		
			{	Emp.						-	-	-	-	-	1	10
					Non-emp.					-	-	-	1	-	-	-

NOTE.—The Banes Division and the Preston Division did not operate any Field Dispensaries during the year 1929



[illegible]

DEATHS BY AGE

Age and Sex:		Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
		T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Under 1 year	{ M. . .	-	-	-	11	-	-	1	2	-	-	-	3	-	-	-	3	-	-	-	-
	{ F. . .	-	-	-	10	-	-	-	-	-	-	-	1	-	-	-	4	-	-	-	-
1 to 5 years	{ M. . .	-	-	-	10	-	-	-	1	-	-	-	3	-	-	-	7	-	-	-	-
	{ F. . .	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-
6 to 10 years	{ M. . .	-	-	-	5	-	-	-	-	-	-	-	1	-	-	-	3	-	-	-	-
	{ F. . .	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
11 to 20 years	{ M. . .	-	1	-	-	-	6	-	-	-	-	-	3	-	1	-	-	-	7	-	-
	{ F. . .	-	-	-	3	-	-	-	2	-	-	-	1	-	-	-	6	-	-	-	-
21 to 30 years	{ M. . .	1	12	1	-	-	8	-	2	-	12	1	4	-	15	-	6	-	16	1	1
	{ F. . .	-	-	-	6	-	-	-	3	-	-	-	6	1	1	-	8	-	1	-	1
31 to 40 years	{ M. . .	-	6	-	-	-	5	1	1	-	24	-	3	1	15	-	11	1	12	-	-
	{ F. . .	-	-	-	5	-	-	-	1	-	-	-	3	-	-	-	7	-	1	-	-
41 to 50 years	{ M. . .	1	4	-	1	1	3	-	2	-	12	1	-	3	23	1	10	1	8	1	-
	{ F. . .	-	-	-	1	-	-	-	1	-	-	-	2	-	1	-	8	-	-	-	-
51 to 60 years	{ M. . .	-	5	-	-	-	3	-	-	-	2	-	-	-	16	-	11	-	3	1	-
	{ F. . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-
61 to 70 years	{ M. . .	-	2	-	-	-	-	-	-	-	-	-	-	-	9	-	8	-	1	-	-
	{ F. . .	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Over 70 years	{ M. . .	-	1	-	1	-	-	-	-	-	-	-	1	-	2	-	1	-	-	-	1
	{ F. . .	-	-	1	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Unknown or Unstated	{ M. . .	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-
	{ F. . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
SEMI-TOTALS	{ M. . .	2	31	1	28	1	25	2	8	-	52	2	18	4	81	1	62	2	47	4	3
	{ F. . .	-	-	1	35	-	-	-	7	-	-	-	14	1	2	1	48	-	2	-	2
TOTALS . . . . .		2	31	2	63	1	25	2	15	-	52	2	32	5	83	2	110	2	49	4	5

APPENDIX

Deaths, Hospitals . . .	1	25	2	30	1	24	1	9	-	48	2	28	3	64	2	91	2	49	4	5
Deaths, Hospital Dispensaries . . . . .	1	6	-	33	-	-	1	-	-	3	-	4	-	6	-	15	-	-	-	-
Deaths, Field Dispensaries . . . . .	-	-	-	-	-	-	-	1	-	-	-	-	1	10	-	3	-	-	-	-
*Deaths, Others . . . . .	-	-	-	-	-	1	-	5	-	1	-	-	1	3	-	1	-	-	-	-

\* Deaths occurring within the Company's property, of persons who did not receive medical attendance.

## ACTIVITY AND SEX

Jamaica Division				Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-Totals				
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Total
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
-	-	-	-	-	-	-	1	-	-	1	36	-	-	-	4	-	-	-	4	-	-	2	67	69
-	-	-	1	-	-	-	1	-	-	-	41	-	-	-	4	-	-	-	3	-	-	-	67	67
-	-	-	-	-	-	-	4	-	-	-	10	-	-	-	4	-	-	-	4	-	-	-	45	45
-	-	-	1	-	-	-	2	-	-	-	9	-	-	2	6	-	-	-	3	-	-	2	31	33
-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	1	-	-	-	1	-	-	-	15	15
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5
-	2	-	-	-	1	1	1	-	6	-	1	-	9	-	1	-	8	-	-	-	41	1	9	51
-	-	-	-	-	-	-	6	-	-	-	8	-	-	-	3	-	-	-	6	-	-	-	38	38
-	2	1	-	1	4	-	2	-	19	-	2	-	13	-	4	-	34	-	4	2	135	4	34	175
-	-	-	-	-	-	-	4	-	-	-	9	-	-	-	5	-	-	1	6	1	2	1	59	63
-	2	-	-	-	5	-	5	1	15	2	3	-	14	-	-	-	14	2	1	3	112	5	30	150
-	1	-	-	-	1	-	2	-	-	-	11	-	-	-	6	-	-	2	-	-	3	2	38	43
-	4	-	-	-	10	-	2	1	9	-	6	-	4	2	1	-	5	-	1	7	82	5	26	120
-	-	-	-	-	1	-	3	-	-	-	3	-	-	-	2	-	-	-	2	-	2	-	25	27
-	2	-	-	-	5	-	-	2	5	-	2	-	2	-	-	-	-	-	1	2	43	1	17	63
-	2	-	-	-	-	-	-	-	1	-	2	-	-	-	3	-	-	-	1	-	3	-	12	15
-	-	-	-	-	4	-	1	-	3	1	2	1	1	1	1	-	1	1	-	1	21	3	12	37
-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	7	-	7
1	-	-	-	-	2	-	-	-	1	-	2	-	-	-	-	-	-	-	2	1	6	1	7	15
-	-	-	1	-	-	-	-	-	-	-	6	-	-	-	1	-	-	1	-	-	-	3	13	16
-	-	-	-	-	1	-	-	-	-	-	1	-	4	-	1	-	18	-	7	-	25	-	11	36
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	-	-	-	2	-	-	-	7	7
1	12	1	-	1	32	1	17	4	58	4	67	1	47	3	17	-	80	3	25	16	465	22	273	776
-	3	-	3	-	2	-	20	-	1	-	93	-	-	2	33	-	-	4	23	1	10	8	302	321
1	15	1	3	1	34	1	37	4	59	4	160	1	47	5	50	-	80	7	48	17	475	30	575	1,097
-	1	1	-	1	28	-	34	3	49	1	36	1	43	5	46	-	63	7	41	12	394	25	366	797
1	8	-	1	-	1	-	2	1	3	3	94	-	-	-	-	-	-	-	-	3	27	4	149	183
-	6	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	17	-	6	24
-	-	-	-	-	4	1	1	-	7	-	30	-	4	-	4	-	17	-	7	1	37	1	54	93



## DEATHS BY NATIVITY

NATIVITY:	Banes Divi- sion	Chiri- qui Land Co.	Colom- bia Divi- sion	Costa Rica Divi- sion	Guate- mala Divi- sion	Jamaica Divi- sion	Panama Divi- sion	Preston Divi- sion	Tela Rail- road	Trux- illo Rail- road	To
Argentine . . . . .	-	-	1	-	-	-	-	-	-	-	
Barbados . . . . .	-	-	-	3	-	-	2	1	-	-	
British Honduras . . . . .	-	-	-	-	6	-	-	-	-	2	
British West Indies (other than Jamaica and Barbados) . . . . .	1	-	2	7	-	-	5	3	-	-	1
Canary Islands . . . . .	1	-	-	-	-	-	-	-	-	-	
China . . . . .	1	-	-	1	1	-	1	2	1	-	
Colombia . . . . .	-	-	78	2	-	-	3	-	1	-	8
Costa Rica . . . . .	-	2	-	82	1	-	2	-	-	-	8
Cuba . . . . .	58	-	-	-	-	-	-	139	-	1	19
Czecho-Slovakia . . . . .	-	-	-	-	1	-	-	-	-	-	
Dutch West Indies . . . . .	-	-	1	-	-	-	-	-	1	-	
England . . . . .	-	-	1	2	2	2	1	-	-	-	
Finland . . . . .	-	-	-	-	-	-	-	-	-	1	
French West Indies . . . . .	-	-	-	-	-	-	2	-	-	-	
Germany . . . . .	-	-	-	1	-	-	-	-	-	-	
Guatemala . . . . .	-	1	-	-	78	-	-	-	-	-	7
Haiti . . . . .	14	-	-	-	-	-	-	31	-	-	4
Honduras . . . . .	-	-	-	-	6	-	-	-	68	87	16
India . . . . .	-	-	-	-	1	2	-	-	1	-	
Italy . . . . .	-	-	-	1	-	-	-	-	1	-	
Jamaica . . . . .	20	8	1	72	6	16	31	37	6	2	19
Mexico . . . . .	-	-	-	-	-	-	-	-	-	2	
Nicaragua . . . . .	-	14	-	19	-	-	3	-	2	5	4
Norway . . . . .	-	-	-	-	-	-	1	-	-	-	
Palestine . . . . .	-	-	-	-	-	-	-	1	3	-	
Panama . . . . .	-	14	-	4	-	-	21	-	-	-	3
Peru . . . . .	-	-	-	1	-	-	-	-	-	-	
Porto Rico . . . . .	-	-	-	-	-	-	-	4	-	-	
Salvador . . . . .	-	1	-	-	6	-	1	-	8	4	2
Spain . . . . .	3	2	1	-	-	-	-	8	-	1	
Syria . . . . .	-	-	-	-	-	-	-	-	-	1	
United States . . . . .	-	1	-	3	4	-	-	-	3	4	
United States West Indies . . . . .	-	-	-	-	-	-	-	1	-	-	
Unknown or unstated . . . . .	-	-	1	2	-	-	-	-	8	25	3
TOTALS . . . . .	98	43	86	200	112	20	73	227	103	135	1,000







[illegible]



Y DISEASE—Continued

Jamaica Division			Panama Division			Preston Division			Tela Railroad			Truxillo Railroad			Semi-totals			Total	Deaths in Hospitals					
Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.		Emp.	Non-Emp.	T. O.			
T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.								
-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	1	-	3	4	-	1	-	2
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	1	2	-	1	-	1
-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	2	-	1	3	-	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-	-	2	-	2	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	2
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	3	4	-	-	1	3	
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	4	-	4	8	-	4	-	3
-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1	-	2	-	1	1	-
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## CLASSIFICATION OF DEATHS

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division		Guatemala Division	
	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.
<b>DISEASES OF THE CIRCULATORY SYSTEM—</b>										
Continued										
Acute endocarditis and myocarditis:										
Acute endocarditis . . . . .	-	-	-	1	-	-	-	-	-	-
Acute myocarditis . . . . .	-	-	-	-	-	1	-	-	-	-
Angina pectoris . . . . .	-	-	-	-	-	-	1	1	-	-
Other diseases of the heart:										
Chronic endocarditis . . . . .	-	-	-	-	-	-	-	-	-	-
Chronic myocarditis . . . . .	-	1	-	-	-	3	-	8	4	-
Other chronic diseases of the heart . . . . .	-	1	-	1	1	2	-	10	4	-
Aneurism . . . . .	-	-	-	-	-	-	-	-	-	1
Atheroma and other diseases of the arteries . . . . .	-	-	-	-	-	-	2	-	-	-
Embolism and thrombosis (except cerebral) . . . . .	-	-	-	-	1	-	-	-	1	-
<b>DISEASES OF THE RESPIRATORY SYSTEM:</b>										
Diseases of the larynx (except tubercu- losis and cancer) . . . . .	-	-	-	-	-	-	-	-	-	-
Bronchitis:										
Acute . . . . .	-	-	3	-	-	-	-	-	-	-
Not otherwise defined under 5 years of age . . . . .	-	-	-	-	-	-	-	-	-	-
Bronchopneumonia (including capillary bronchitis):										
Bronchopneumonia . . . . .	1	1	10	-	1	3	2	4	-	-
Capillary bronchitis . . . . .	-	-	-	-	-	1	-	-	-	-
Pneumonia:										
Lobar . . . . .	-	-	-	3	1	17	5	1	4	17
Not otherwise specified . . . . .	-	-	-	-	2	-	2	4	-	-
Pleurisy:										
Empyema of thoracic cavity . . . . .	-	-	-	-	-	-	-	-	-	-
Congestion or parenchymatous hemor- rhage of the lung . . . . .	-	-	-	-	-	-	1	-	-	-
Gangrene of the lung . . . . .	-	-	-	-	-	-	-	-	1	-
Other diseases of the respiratory system (tuberculosis excepted):										
Others . . . . .	-	-	-	-	1	-	-	-	-	-
<b>DISEASES OF THE DIGESTIVE SYSTEM:</b>										
Diseases of the mouth and adnexa:										
Other diseases of the buccal cavity and adnexa . . . . .	-	-	-	-	-	1	-	-	-	-
Diseases of the pharynx and tonsils (in- cluding adenoids):										
Ludwig's angina . . . . .	-	-	-	-	-	-	-	-	1	-
Others . . . . .	-	-	-	-	-	-	1	-	-	-
Ulcer of the stomach and duodenum:										
Ulcer of the stomach . . . . .	-	-	-	-	1	-	-	-	1	1
Ulcer of the duodenum . . . . .	-	-	-	-	-	-	-	-	-	-
Other diseases of the stomach (cancer excepted):										
Others . . . . .	-	-	-	-	-	-	3	-	-	-
Diarrhea and enteritis (under 2 years of age) . . . . .	-	-	18	-	-	1	-	1	-	-
Diarrhea and enteritis (2 years and over). Appendicitis and typhlitis . . . . .	-	-	-	-	1	-	1	-	-	-
Appendicitis and typhlitis . . . . .	-	1	1	-	1	-	-	-	-	-
Hernia, intestinal obstruction:										
Hernia . . . . .	-	-	-	-	1	-	1	1	-	-
Intestinal obstruction . . . . .	-	-	-	-	2	1	2	1	1	-

## Y DISEASE—Continued

Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-totals		Total	Deaths in Hospitals	
Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.		Emp.	Non-Emp.
T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.		T. O.	T. O.
-	-	-	-	-	1	-	2	-	-	-	3	4	-	3
-	-	-	-	-	2	-	-	1	-	3	5	8	-	3
-	-	-	-	-	1	-	-	-	-	1	1	3	-	-
-	-	-	-	-	1	-	-	-	-	-	1	1	-	-
-	-	-	1	-	4	-	-	2	-	16	14	30	-	16
-	-	-	2	-	1	-	1	1	-	22	8	31	-	12
1	-	-	1	-	-	-	-	-	-	4	1	5	-	3
-	-	-	1	-	1	-	-	-	-	3	1	6	-	2
-	-	-	-	-	-	-	-	-	-	1	1	2	1	1
-	-	-	-	-	-	-	-	-	-	1	-	2	-	1
-	-	-	-	-	1	-	-	-	-	-	1	1	-	-
-	-	-	-	-	-	-	-	-	-	-	3	3	-	-
-	-	-	-	1	-	-	-	-	-	-	1	1	-	1
1	-	-	-	-	1	-	3	1	-	12	43	56	1	10
-	-	-	-	-	-	-	1	-	-	1	1	2	-	1
-	-	-	3	-	1	-	5	1	3	66	4	108	-	64
1	-	-	-	-	-	-	-	-	3	3	9	12	-	2
-	-	-	-	-	-	-	-	-	1	-	1	1	-	-
-	-	-	-	-	-	-	-	-	-	1	-	1	-	1
-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
-	-	-	-	1	2	-	-	-	-	1	3	4	-	1
-	-	-	-	-	-	-	-	-	-	-	1	1	-	1
-	-	-	-	-	-	-	-	-	-	1	-	1	-	1
-	-	-	-	-	-	-	-	-	-	3	1	4	-	3
-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
-	-	-	-	-	-	-	1	-	-	4	-	4	-	2
-	-	-	-	-	40	-	-	1	-	-	62	62	-	-
-	-	-	-	-	5	-	-	-	-	4	5	9	-	2
-	-	-	1	-	1	-	-	-	-	3	2	5	-	3
-	-	-	-	-	1	-	-	-	-	2	2	4	-	1
-	-	-	-	-	1	-	-	-	-	6	3	9	-	5

## CLASSIFICATION OF DEATH

	Banes Division		Chiriquí Land Co.		Colombia Division		Costa Rica Division		Guatemala Division	
	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	No. Em.
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T.
<b>DISEASES OF THE DIGESTIVE SYSTEM—</b>										
Continued										
Other diseases of the intestines:										
Diseases of the anus and stercoral fistulae . . . . .	-	- -	-	- -	- 1 - -	- - - -	- - - -	- - - -	- - - -	- - - -
Other diseases of the intestines . . . . .	-	- -	- 2 - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Acute yellow atrophy of the liver . . . . .	-	- -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Cirrrosis of the liver:										
Returned as alcoholic . . . . .	-	- -	- - - -	- - - -	- - - -	- - - -	- - - -	1 - - -	- - - -	- - - -
Not returned as alcoholic . . . . .	- 1 - -	- - - -	- - - -	- - - -	- 1 - -	- - - -	- 1 - -	1 - - -	- - - -	- - - -
Other diseases of the liver:										
Other diseases of the liver . . . . .	-	- -	- - - -	- - - -	- - - -	2 - - -	- 1 - -	2 - - -	- - - -	- - - -
Diseases of the pancreas (except cancer) . . . . .	-	- -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Peritonitis of unstated cause . . . . .	-	- -	- - - -	- - - -	- - - -	- - - -	- - 1 -	4 - - -	- - - -	- - - -
Other diseases of the digestive system (cancer and tuberculosis excepted) . . . . .	-	- -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
<b>NON-VENEREAL DISEASES OF THE GENITO-URINARY SYSTEM AND ITS ADNEXA:</b>										
Acute nephritis (including unspecified under 10 years of age) . . . . .	- - - 1	- - - -	- 1 - -	- - - -	- 1 - -	- - - -	- - - -	- - - -	- - - -	- - - -
Chronic nephritis (including unspecified over 10 years of age). . . . .	- 6 - 1	- - - -	1 1 - -	- - - -	- 1 - 1	- - - -	- 2 - 1	- - - -	- - - -	1 - - -
Other diseases of the kidneys and their adnexa (diseases of the kidney in pregnancy not included). . . . .	- - - -	- - - -	- 1 - -	- - - -	- - - 1	- - - -	- - - 2	- - - -	- - - -	- - - -
Calculi of the urinary passages . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Diseases of the urethra, urinary abscess, etc.: . . . . .										
Stricture of the urethra . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Others . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - 1	- - - -	- - - -	- - - -
Diseases of the prostate (except tumors). . . . .	- 1 - 1	- - - -	- - - -	- - - -	- - - -	- - - -	- 1 - -	- - - -	- - - -	- - - -
Cysts and other benign tumors of the ovary . . . . .	- - - 1	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Salpingitis or pelvic abscess . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
<b>THE PUERPERAL STATE:</b>										
Accidents of pregnancy:										
Abortion . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Ectopic gestation . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	1 1 - -	- - - -	- - - -	- - - -
Other accidents of pregnancy . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Puerperal hemorrhage . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	1 - - -	- - - -	- - - -	- - - -	- - - -
Other accidents of childbirth:										
Others . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Puerperal septicemia . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	1 - - -	- - - 1	- - - -	- - - -	- - - -
Puerperal albuminuria or convulsions . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	1 - - -	- - - 1	- - - -	- - - -	- - - -
<b>DISEASES OF THE SKIN AND OF THE CELLULAR TISSUE:</b>										
Gangrene . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- 1 - 1	- - - -	- - - -	- - - -
Boil, carbuncle, furuncle . . . . .	- - - 1	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
<b>DISEASES OF THE BONES AND OF THE ORGANS OF LOCOMOTION:</b>										
Diseases of the bones (tuberculosis excepted) . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
<b>MALFORMATIONS:</b>										
Congenital malformations (still-births excepted): . . . . .										
Others . . . . .	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - 1	- - - -	- - - -	- - - -



## Y DISEASE—Continued

Jamaica Division			Panama Division			Preston Division			Tela Railroad			Truxillo Railroad			Semi-totals			Total	Deaths in Hospitals		
mp.	Non-Emp.	T. O.	Emp.	Non-Emp.	T. O.	Emp.	Non-Emp.	T. O.	Emp.	Non-Emp.	T. O.	Emp.	Non-Emp.	T. O.	Emp.	Non-Emp.	T. O.		Emp.	Non-Emp.	T. O.
O.	T. O.		T. O.	T. O.		T. O.	T. O.		T. O.	T. O.		T. O.	T. O.		T. O.	T. O.				T. O.	
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	1	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	2	4	-	2	-	-	2
-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	1	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	2	-	1	-	1	-
-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	4	8	-	4	-	4	-
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	1	-	-	-
-	-	-	-	1	2	-	-	-	-	-	-	1	1	7	9	-	1	1	1	6	6
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	5	-	2	-	2	2
4	-	-	-	2	-	1	2	-	2	-	3	-	-	1	1	33	2	16	2	6	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	3	4	-	1	-	3	3
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	-
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	3	-	1	-	2	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-
-	-	-	-	1	-	-	-	-	-	-	-	-	3	-	1	4	-	2	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-
-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	2	2	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	2	-	1	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	2	-
-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3	3	-	-	-	2	-
-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	5	5	-	-	-	5	-
-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	4	4	-	-	-	4	-
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	7	7	-	-	-	7	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	1	-	1	-
-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	3	-	1	-	1	-
-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3	3	-	-	-	-	1

## CLASSIFICATION OF DEATHS

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division		Guatemala Division						
	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.					
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.					
DISEASES OF EARLY INFANCY:															
Congenital debility, icterus and sclerema:															
Marasmus. . . . .	-	-	-	-	-	-	-	-	7	-					
Inanition . . . . .	-	-	1	-	-	-	-	-	1	-					
Others . . . . .	-	-	-	-	-	-	-	-	1	-					
Premature birth, or consequence of labor:															
Premature birth. . . . .	-	-	-	1	-	2	-	-	-	-					
Injury at birth . . . . .	-	-	1	-	-	-	-	-	-	-					
Other diseases peculiar to early infancy:															
Asphyxia neonatorum . . . . .	-	-	-	-	-	-	-	-	-	-					
Others . . . . .	-	-	-	-	-	-	-	-	-	-					
Lack of care . . . . .	-	-	-	-	-	-	-	-	-	-					
OLD AGE:															
Old age . . . . .	-	-	-	-	-	1	-	-	2	1					
EXTERNAL CAUSES:															
Suicide . . . . .	-	1	-	6	-	1	-	-	-	-					
Snake bite . . . . .	-	-	-	-	-	-	-	-	1	-					
Other acute poisonings . . . . .	-	-	-	-	-	-	-	-	1	-					
Accidental drowning. . . . .	-	-	-	-	-	1	-	-	-	-					
Injury by firearms. . . . .	-	-	1	-	-	-	1	3	-	-					
Injury by cutting or piercing instruments.	-	-	-	-	-	-	-	1	1	-					
Injury by falls . . . . .	-	-	-	-	-	-	-	-	1	-					
Traumatism by machines . . . . .	1	-	-	-	-	-	-	-	-	-					
Traumatism by other crushing (vehicles, railways, landslides, etc.) . . . . .	-	-	2	-	2	1	2	-	-	-					
Injuries by animals (not poisoning) . . . . .	-	1	-	-	-	-	-	-	-	-					
Electricity . . . . .	-	-	-	-	-	-	-	-	-	-					
Homicide by firearms . . . . .	-	-	-	1	-	-	-	-	-	-					
Homicide by cutting or piercing instru- ments. . . . .	-	-	-	-	-	-	-	-	-	1					
Homicide by other means . . . . .	-	-	-	-	-	1	-	-	-	1					
Dislocations. . . . .	-	-	-	-	-	1	-	-	-	-					
Fractures (cause not specified). . . . .	-	-	-	-	-	2	-	-	1	-					
Other external violence:															
Explosions . . . . .	-	-	-	-	-	-	-	1	-	-					
Other external violence . . . . .	-	-	-	-	-	-	-	1	-	1					
ILL-DEFINED DISEASES:															
Ill-defined organic diseases . . . . .	-	-	-	-	-	-	3	-	-	1					
Sudden death . . . . .	-	-	-	1	-	-	-	1	-	-					
Infections of undetermined origin . . . . .	-	-	-	1	-	-	1	-	1	-					
Unstated . . . . .	-	-	-	1	-	-	-	-	-	-					
TOTALS . . . . .	2	31	2	63	1	25	2	15	5	83	2	110	2	49	4

NOTE.—This table includes *all* deaths. See appendix of table on pages 378-379.

Y DISEASE—*Concluded*

Jamaica Division			Panama Division			Preston Division			Tela Railroad			Truxillo Railroad			Semi-totals				Total	Deaths in Hospitals							
Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.							
T. O.	T. O.		T. O.	T. O.		T. O.	T. O.		T. O.	T. O.		T. O.	T. O.		T. O.	T. O.		T. O.		T. O.							
-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	9	9	-	-	-	3				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	1				
-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	4	4	-	-	-	1				
-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	10	10	-	-	-	8				
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	4	-	-	2	2	-	-	-	2				
-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	2	2	-	-	-	1				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	1				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	1				
1	-	1	-	-	-	-	-	5	-	-	1	-	-	-	-	1	3	1	9	14	-	1	1	2			
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	6	8	-	1	-	2				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	1	-	1				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1				
-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	4	-	-	4	-	-	-	-				
-	-	-	-	-	1	-	2	2	1	5	1	-	2	-	1	8	2	7	18	1	7	2	6				
-	-	-	-	2	-	-	2	-	-	1	-	-	1	-	-	7	-	1	8	-	7	-	1				
-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2	-	1	3	-	2	-	1				
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2	-	-	-	-				
1	-	-	-	1	-	1	-	1	-	1	-	3	-	-	-	10	1	10	21	-	8	1	9				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-				
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-				
-	-	-	-	1	-	-	-	-	-	-	-	3	-	2	-	4	-	3	7	-	1	-	2				
-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	3	-	10	-	4	14	-	2	-	1			
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	1	-	-				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-				
-	-	-	-	1	1	-	-	-	-	1	1	-	-	-	1	5	2	3	10	-	4	1	3				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	1	-	-	-				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	6	-	2	1	2				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-	-	-	2				
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2	-	-	-	-				
-	-	-	-	-	1	-	-	2	-	3	-	8	-	2	-	7	-	14	21	-	4	-	10				
-	-	-	-	-	-	-	-	-	-	5	-	4	-	-	-	5	-	5	10	-	-	-	-				
15	1	3	1	34	1	37	4	59	4	160	1	47	5	50	-	80	7	48	17	475	30	575	1,097	12	394	25	366



## RECORD OF

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division		Guatemala Division	
	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.
EPIDEMIC, ENDEMIC OR INFECTIOUS DISEASES:										
Tuberculosis of the respiratory system:										
Acute pulmonary tuberculosis . . .	- 1	- -	- -	- -	1 31	- -	- 1	- -	- -	- -
Other forms of tuberculosis of respiratory organs . . . . .	- -	- -	- 1	- -	- -	- -	- -	- -	- -	- -
Tuberculosis of the vertebral column . . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Disseminated tuberculosis:										
Acute (including miliary tuberculosis of the lungs, except that specified as chronic or pulmonary) . . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Syphilis (including syphilitic infection of any organ, tissue or structure of the body):										
Tertiary . . . . .	- -	- -	- 1	- -	- -	- -	- -	- -	- -	- -
Period not specified . . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
GENERAL DISEASES NOT INCLUDED ABOVE:										
Cancer or other malignant tumors of the stomach and liver:										
Cancer of the stomach . . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Cancer or other malignant tumors of other or unspecified organs:										
Others . . . . .	- -	- -	- -	- -	- 2	- -	- -	- -	- -	- -
Beriberi . . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
Diabetes . . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Anemia, chlorosis:										
Other anemias and chlorosis . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
Disease of the spleen . . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
DISEASES OF THE NERVOUS SYSTEM AND OF THE ORGANS OF SPECIAL SENSE:										
Progressive locomotor ataxia (tabes dorsalis) . . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Chorea:										
Neuritis . . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
Diseases of the organs of vision and adnexa (except gonococcal infection):										
Diseases of the eye (except tumor). . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Trachoma . . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
Other diseases of the eye or its adnexa. . . . .	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
DISEASES OF THE CIRCULATORY SYSTEM:										
Other diseases of the heart:										
Chronic myocarditis . . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
Other chronic diseases of the heart. . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
Atheroma and other diseases of the arteries . . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -
DISEASES OF THE RESPIRATORY SYSTEM:										
Bronchitis:										
Acute . . . . .	- -	- -	- -	- -	- 1	- -	- -	- -	- -	- -

Jamaica Division				Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		
-	-	-	-	-	2	-	-	-	4	-	-	-	10	-	-	-	2	-	-	1	51	-	-	52
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1

RECORD OF REPA

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division		Guatemala Division	
	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.
DISEASES OF THE DIGESTIVE SYSTEM:										
Hernia, intestinal obstruction:										
Hernia . . . . .	-	-	-	-	-	1	-	-	-	-
Other diseases of the intestines:										
Diseases of the anus and stercoral fistulae. . . . .	-	-	-	-	-	1	-	-	-	-
Cirrhosis of the liver:										
Not returned as alcoholic. . . . .	-	-	-	-	-	3	-	-	-	-
NON-VENEREAL DISEASES OF THE GENI- TOURINARY SYSTEM AND ITS ADNEXA:										
Chronic nephritis (including un- specified over 10 years of age) . . . . .	-	-	-	-	-	2	-	-	-	-
DISEASES OF THE SKIN AND OF THE CELLULAR TISSUE:										
Other diseases of the skin and its adnexa:										
Ulcer of the skin . . . . .	-	-	-	-	-	1	-	-	-	-
DISEASES OF THE BONES AND OF THE ORGANS OF LOCOMOTION:										
Diseases of the bones (tuberculosis excepted) . . . . .	-	-	-	-	-	1	-	-	-	-
Diseases of the joints (tuberculosis and rheumatism excepted) . . . . .	-	-	-	-	-	1	-	-	-	-
EXTERNAL CAUSES:										
Injury by cutting or piercing instruments . . . . .	-	-	-	-	-	1	-	-	-	-
Traumatism by other crushing (ve- hicles, railways, landslides, etc.) . . . . .	-	-	-	-	-	-	-	-	-	-
TOTALS. . . . .	-	1	-	2	-	1 53	-	1	-	-



RIATIONS—Concluded

Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Semi-Totals		
Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Total
T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	
-	-	-	-	-	-	-	-	-	-	-	1	1
-	-	-	-	-	-	-	-	-	-	-	1	1
-	-	-	-	-	-	-	-	-	-	-	3	3
-	-	-	-	-	-	-	-	-	-	-	2	2
-	-	1	-	-	-	-	-	-	-	-	2	2
-	-	-	-	-	-	-	-	-	-	-	1	1
-	-	-	-	-	-	-	-	-	-	-	1	1
-	-	-	-	-	-	-	-	-	-	-	1	1
-	-	-	-	-	1	-	-	-	-	-	1	1
-	-	13	-	8	-	10	-	1	2	2	90	92

## CLASSIFICATION OF DISEASE

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
Epidemic, Endemic or Infectious Diseases:																				
Typhoid fever (abdominal typhoid and paratyphoid):																				
Typhoid fever. . . . .																				
Paratyphoid fevers . . . . .																				
Typhus fever (exanthematous). . . . .																				
Relapsing fever (spirillum obermeieri) . . . . .																				
Melito cocciosis (Malta fever) . . . . .																				
Malarial fever or cachexia:																				
Estivo-autumnal . . . . .																				
Tertian . . . . .																				
Quartan. . . . .																				
Mixed. . . . .																				
Clinical . . . . .																				
Cachexia . . . . .																				
Hemoglobinuric fever . . . . .																				
Smallpox . . . . .																				
Measles . . . . .																				
Scarlet fever . . . . .																				
Whooping cough. . . . .																				
Diphtheria . . . . .																				
Influenza (complications):																				
Pneumonia . . . . .																				
Bronchitis. . . . .																				
Heart disease . . . . .																				
Nephritis . . . . .																				
Meningitis . . . . .																				
Gastro-intestinal . . . . .																				
Puerperal . . . . .																				
Others . . . . .																				
Miliary fever . . . . .																				
Mumps . . . . .																				
Asiatic cholera . . . . .																				
Cholera nostras (choleric form enteritis) . . . . .																				
Dysentery:																				
Amebic . . . . .																				
Bacillary . . . . .																				
Unspecified or due to other causes. . . . .																				
Plague:																				
Bubonic. . . . .																				
Pneumonic . . . . .																				
Septicemic . . . . .																				
Unspecified . . . . .																				
Yellow fever . . . . .																				
Ictero-hemorrhagica spirochetosis . . . . .																				
Leprosy . . . . .																				
Erysipelas. . . . .																				
Acute poliomyelitis . . . . .																				
Encephalitis lethargica . . . . .																				
Epidemic cerebrospinal meningitis . . . . .																				
Other epidemic diseases:																				
Alastrim or Kaffir milk-pox . . . . .																				
Varicella . . . . .																				
Filariasis . . . . .																				
Dengue . . . . .																				
Yaws . . . . .																				
Others . . . . .																				
Purulent or septicemic infection . . . . .																				
Glanders and farcy . . . . .																				

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.			Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.			Non-Emp.			
O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.		
-	-	-	-	3	1	6	4	13	-	3	-	-	-	7	46*	3*	50	106*	-	8	-	10	
1	-	1	-	-	-	-	-	-	-	-	-	-	-	1	8	1	8	18	1	1	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
110	1	93	16	104	-	18	24	656	13	117	26	669	11	157	239*	3204*	54	935	4432*	2	19	2	29
6	1	9	3	11	-	1	4	98	1	12	11	110	5	33	105*	598	20	224	947*	-	1	-	3
7	-	1	-	-	-	-	2	16	-	3	-	8	1	3	6	50	3	17	76	-	-	-	-
2	-	3	-	-	-	-	2	15	-	2	4	38	-	13	7	96	2	85	190	-	1	-	1
11	-	4	-	4	-	2	1	33	2	4	2	11	1	9	27*	198	4	59	288*	-	-	-	-
29	-	4	-	-	-	-	-	6	-	2	-	1	-	-	1*	54	-	7	62*	-	3	-	-
5	-	1	1	2	-	1	-	6	1	-	2	22	-	1	5	75	2	15	97	2	12	1	6
-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
1	-	-	-	-	-	-	-	5	-	1	-	-	-	-	1	25	1	6	33	-	-	-	-
-	-	-	-	-	-	6	-	-	-	-	-	-	-	2	-	1	-	-	1	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	12	12	-	-	-	-
-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	2	10	13	-	-	-	-
1	-	-	-	-	-	-	-	51	-	6	-	4	-	1	17	107	9	37	170	-	6	-	1
-	-	-	-	-	-	-	1	6	-	10	1	15	-	9	15*	174*	5*	42	236*	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	2	-	-	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3	-	-	3	-	-	-	-
-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	3	1	1	-	5	-	-	-	-
19	2	8	3	27	-	9	27	480	11	39	13	95	1	20	58	779	15	107	959	-	-	-	-
2	-	-	-	2	-	1	-	5	-	-	-	-	-	-	1	15	-	3	19	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	1	1	1	-	3	7	43	1	31	2	24	-	10	19	205	13	88	325	-	2	-	4
1	-	-	-	3	-	1	-</																



## CLASSIFICATION OF DISEASES

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>Epidemic, Endemic or Infectious Diseases—Continued</b>																				
Malignant pustule (anthrax) . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rabies . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetanus . . . . .	-	1	-	3	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Mycoses . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis of the respiratory system:																				
Acute pulmonary tuberculosis . .	1	19	1	2	-	1	-	-	1	44	-	1	-	31	1	26	1	20	1	
Other forms of tuberculosis of the respiratory organs . . . . .	-	-	-	-	1	7	-	-	-	2	-	-	-	1	-	1	-	1	-	-
Tuberculosis of the meninges or of the central nervous system . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis of the intestines or peritoneum . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis of the vertebral column.	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Tuberculosis of the joints . . . . .	-	1	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Tuberculosis of other organs and structure:																				
Tuberculosis of the skin and subcutaneous cellular tissue . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Tuberculosis of the bones (except vertebral column) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Tuberculosis of the lymphatic system (except the mesenteric and retroperitoneal glands) . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis of the genitourinary system . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis of other organs . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Disseminated tuberculosis:																				
Acute (including miliary tuberculosis of the lungs, except that specified as chronic or pulmonary) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
Chronic . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syphilis (includes syphilitic infection of any organ, tissue or structure of the body):																				
Primary . . . . .	-	-	-	-	1	3	-	-	-	-	1	1	-	13	-	4	1	14	-	-
Secondary . . . . .	-	16	-	1	-	-	-	-	-	10	-	-	-	20	-	6	-	8	-	-
Tertiary . . . . .	1	2	-	-	2	39	1	10	1	95	1	5	1	72	1	27	-	19	1	-
Hereditary . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Period not specified . . . . .	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	3	-	-
Soft chancre . . . . .	-	-	-	-	-	-	1	-	-	66	2	5	-	77	11	16	-	9	-	-
Gonococcal infection, except that of the eye or adnexa . . . . .	-	23	-	3	7	13	-	3	1	102	5	11	1	79	15	33	2	28	6	-
Gonococcal ophthalmia . . . . .	-	1	-	-	-	-	1	-	-	2	-	2	-	-	-	-	-	-	-	-
<b>General Diseases Not Included Above:</b>																				
Cancer or other malignant tumors of the buccal cavity:																				
Cancer of the lip . . . . .	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cancer of the tongue . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cancer of the mouth . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Cancer of the jaw . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Cancer or other malignant tumors of the stomach and liver:																				
Cancer of the pharynx . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cancer of the esophagus . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-

## TREATED IN HOSPITALS—Continued

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	1	-	-	-	-	3	-	1	-	3	-	1	-	2	-	5	-	12	17	-	4	-	7
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
5	-	4	2	34	2	12	1	61	3	26	2	23	-	10	8	238	8	88	342	-	31	-	22	
-	-	1	-	-	-	-	1	1	-	1	-	14	-	7	2	26	-	10	38	-	3	-	3	
-	-	-	-	-	-	-	-	1	-	1	-	-	-	1	-	1	-	2	3	-	1	-	2	
-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	1	2	-	1	-	-	
-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	5	-	-	5	-	1	-	-	
-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	3	-	2	5	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	1	
-	-	-	-	1	-	-	-	2	-	-	-	1	-	2	-	4	-	2	6	-	-	-	-	
-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	3	3	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	2	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	2	4	-	1	-	2	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	1	5	-	-	1	3	-	2	4	38	1	15	58	-	-	-	-	
-	-	-	-	7	-	-	-	22	-	10	-	1	-	1	-	84	-	22	106	-	1	-	-	
86	-	21	1	39	-	11	1	36	3	50	-	17	1	12	7	405	8	149*	569	-	2	2	5	
-	-	1	-	-	-	1	-	3	-	1	-	-	-	-	-	3	-	5	8	-	-	-	2	
34	-	5	-	-	-	1	-	-	-	1	-	3	-	-	-	43	-	11	54	-	2	-	1	
2	-	1	-	2	-	-	2	69	2	4	-	8	-	1	2	233	15	34	284	-	-	-	-	
31	-	2	1	33	-	3	2	55	9	24	-	49	1	8	14	413	36	99	562	-	-	-	1	
-	-	1	-	-	-	-	-	-	1	2	-	2	-	1	-	5	1	7	13	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	
-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	1	-	-	
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	1	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	

CLASSIFICATION OF DISEASE

	Banes		Chiriqui		Colombia		Costa Rica		Guatemala	
	Division		Land Co.		Division		Division		Division	
	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.	Emp.	Non-Emp.
	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.	T. O.
General Diseases Not Included										
Above— <i>Continued</i>										
Cancer of the stomach. . . . .	-	-	-	-	-	-	-	3	-	1
Cancer of the liver and gall bladder.	-	-	-	1	-	-	-	1	-	-
Cancer or other malignant tumors of the peritoneum, intestines and rectum:										
Cancer of the mesentery and peritoneum. . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the intestines (except rectum). . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the rectum and anus. . . . .	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer or other malignant tumors of the female genital organs:										
Cancer of the ovary and fallopian tubes . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the uterus . . . . .	-	-	-	-	-	5	2	2	-	-
Cancer of the vagina and vulva . . . . .	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer or other malignant tumors of the breast. . . . .	-	-	-	1	-	-	-	-	-	-
Cancer or other malignant tumors of the skin . . . . .	-	-	-	-	-	1	-	-	-	-
Cancer or other malignant tumors of other or unspecified organs:										
Cancer of the larynx . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the lung and pleura . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the pancreas . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the kidneys and suprarenals . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the prostate . . . . .	-	-	-	-	-	-	1	-	-	1
Cancer of the bladder . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the brain . . . . .	-	-	-	-	-	-	-	-	-	-
Cancer of the bones (except jaw). . . . .	-	-	-	1	-	-	-	-	-	-
Cancer of the testes . . . . .	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	1	-	-	-	2	-	1	-	-
Benign tumors and tumors not returned as malignant (except benign or non-specified tumors of the ovary and uterus):										
Tumor of brain . . . . .	-	-	-	-	-	-	-	-	1	-
Tumor of thorax . . . . .	-	-	-	-	-	-	-	-	-	-
Tumor of abdomen . . . . .	-	-	-	-	-	-	-	-	-	-
Tumor of bladder . . . . .	-	-	-	-	-	-	1	-	-	-
Tumor of prostate . . . . .	-	-	-	-	-	-	-	-	-	-
Tumor of other location . . . . .	-	6	-	1	-	2	17	5	1	2
Acute febrile articular rheumatism. . . . .	1	4	-	-	-	2	-	-	1	41
Chronic rheumatism or gout:										
Chronic rheumatism. . . . .	4	12	-	3	-	3	-	1	18	2
Chronic gout . . . . .	-	3	-	-	-	-	-	-	5	-
Scurvy . . . . .	-	-	-	-	-	-	-	-	3	-
Pellagra. . . . .	-	-	-	-	-	-	-	-	1	-
Beriberi. . . . .	-	4	-	-	-	-	14	1	-	-
Rickets . . . . .	-	-	-	1	-	1	-	-	-	-
Diabetes . . . . .	-	-	1	-	-	-	-	-	1	-
Anemia, chlorosis:										
Pernicious anemia. . . . .	-	-	-	2	-	-	1	-	2	3
Other anemias and chlorosis . . . . .	2	4	-	1	-	-	1	24	2	17
Diseases of the pituitary gland . . . . .	-	-	-	-	-	-	-	-	-	-
Diseases of the thyroid gland:										
Exophthalmic goiter. . . . .	-	-	-	-	-	1	-	-	-	-





CLASSIFICATION OF DISEASES

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.	
<b>General Diseases Not Included Above—Continued</b>																				
Other diseases of the thyroid gland.	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Diseases of the parathyroid glands . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of the thymus . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Addison's disease (disease of the adrenals) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Disease of the spleen . . . . .	-	-	-	-	-	-	-	-	64	-	-	-	8	-	2	-	3	-	-	-
Leukemia and Hodgkin's disease:																				
Leukemia . . . . .	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hodgkin's disease . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alcoholism (acute or chronic) . . . . .	-	-	-	-	5	3	-	-	-	-	-	-	4	4	1	2	-	6	1	-
Chronic poisoning by mineral substances . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chronic poisoning by organic substances . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
Other general diseases:																				
Acidosis . . . . .	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amyloid degenerations . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Autointoxications . . . . .	-	-	-	-	-	1	-	-	7	7	1	8	-	-	-	-	-	-	-	-
Hemophilia . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Purpura hemorrhagica . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<b>Diseases of the Nervous System and of the Organs of Special Sense:</b>																				
Encephalitis. . . . .	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meningitis:																				
Simple . . . . .	-	-	-	-	-	-	-	-	-	-	2	-	1	-	1	-	2	-	-	-
Non-epidemic cerebrospinal meningitis . . . . .	-	-	-	-	-	3	-	1	-	-	2	-	1	-	1	-	1	-	-	-
Progressive locomotor ataxia (tabes dorsalis). . . . .	-	-	-	-	-	-	-	-	-	2	-	1	-	1	-	1	-	-	-	-
Other diseases of the spinal cord:																				
Bulbar paralysis (Duchenne's disease) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paralysis agitans (Parkinson's disease) . . . . .	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acute ascending spinal paralysis (Landry's disease). . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myelitis. . . . .	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cerebral hemorrhage, apoplexy:																				
Cerebral hemorrhage . . . . .	-	1	-	-	-	-	-	-	1	-	-	-	3	-	2	-	-	-	-	-
Cerebral thrombosis and embolism. . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paralysis (without specified cause):																				
Hemiplegia . . . . .	-	-	-	-	-	1	-	-	-	-	1	-	4	-	8	-	-	-	-	-
Other forms of paralysis. . . . .	-	-	-	-	-	-	-	-	3	-	1	-	-	-	-	-	1	-	-	-
General paralysis (of the insane). . . . .	-	-	-	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-	-	-
Other forms of mental alienation. . . . .	-	-	-	-	-	-	-	-	1	-	-	-	2	-	3	-	2	-	-	-
Epilepsy. . . . .	-	1	-	1	-	2	-	-	2	-	-	-	3	-	5	1	1	-	-	-
Convulsions (non-puerperal) (5 years and over) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Infantile convulsions (under 5 years of age) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Chorea:																				
Chorea . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hysteria and neuralgia . . . . .	-	10	2	12	-	2	-	1	-	9	-	-	9	-	6	-	3	2	-	-
Neuritis. . . . .	-	2	-	-	1	2	-	1	1	23	1	-	1	7	-	2	-	-	-	-
Softening of the brain. . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of the nervous system. . . . .	-	3	-	-	-	1	-	-	1	3	2	3	1	3	-	-	-	1	1	-

## TREATED IN HOSPITALS—Continued

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
-	1	-	-	-	-	1	1	-	-	-	2	-	-	-	-	-	4	1	3	8	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	38	2	8	1	113	2	13	129	-	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	-	-	-
2	1	-	1	-	1	-	-	3	2	1	1	1	1	-	3	15	18	3	14	50	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	12	1	10	30	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	-	2	3	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	1	3	-	2	-	1
1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	5	-	8	13	-	5	-	6
-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	10	2	2	14	-	6	-	2
1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	6	-	2	8	-	1	-	-
-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-
1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	3	-	2	5	-	1	-	-
-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-
2	-	1	-	-	3	-	1	-	-	-	1	-	1	-	1	-	12*	-	6	18*	-	9	-	6
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1
1	-	1	-	-	-	-	3	-	-	-	1	-	-	-	-	-	6	-	14	20	-	1	-	2
3	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	7	-	3	10	-	-	-	-
1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	4	1	2	7	-	2	1	2
2	-	3	-	-	2	-	1	1	2	2	5	-	2	-	3	1	13	2	15	31	-	1	-	-
1	-	2	-	-	1	-	-	1	4	-	1	-	1	-	2	2	16	-	11	29	-	-	-	-
-	-	-	-	-	-	-	-	-	3	-	1	-	-	-	-	-	3	-	1	4	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	5	5	-	-	-	1
-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-
8	1	2	-	1	2	-	14	2	23	-	4	-	-	-	2	6	66	5	42	119	-	-	-	-
1	-	-	-	1	12	-	5	3	10	-	1	-	4	-	1	7	63*	1	12	83*	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	-	2	-	1	5	3	7	-	6	1	6	3	10	2	6	9	41	9	26	85	-	1	-	-



## CLASSIFICATION OF DISEASES

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.	
	T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>Diseases of the Nervous System and of the Organs of Special Sense—Continued</b>																				
Diseases of the organs of vision and adnexa (except gonococcal in- fection):																				
Diseases of the eye (except tumor).	1	1	-	-	-	3	-	1	-	-	-	-	-	-	1	-	-	1	-	-
Follicular conjunctivitis . . . . .	-	-	-	-	-	1	-	-	-	21	-	3	-	2	-	-	-	15	1	-
Trachoma . . . . .	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-
Tumors of the eye . . . . .	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of the eye or its adnexa . . . . .	2	26	-	3	-	1	-	-	-	34	1	3	3	9	-	3	-	3	-	-
Diseases of the organs of hearing and the mastoid process:																				
Diseases of the ear . . . . .	2	1	-	1	1	3	-	-	2	20	-	2	-	7	-	3	1	3	-	-
Diseases of the mastoid process .	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-
<b>Diseases of the Circulatory System:</b>																				
Pericarditis . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Acute endocarditis and myocarditis:																				
Acute endocarditis . . . . .	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acute myocarditis . . . . .	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	2	-	-
Angina pectoris . . . . .	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of the heart:																				
Chronic endocarditis . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	1	-
Chronic myocarditis . . . . .	-	4	-	-	-	-	-	-	-	11	1	1	-	17	-	12	-	1	1	-
Other chronic diseases of the heart . . . . .	-	1	-	1	-	3	-	1	1	17	-	1	1	14	1	20	1	1	1	-
Aneurism . . . . .	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-
Atheroma and other diseases of the arteries . . . . .	-	2	-	1	1	-	-	-	-	12	1	1	-	2	-	4	-	1	-	-
Embolism and thrombosis (except cerebral) . . . . .	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-
Diseases of the veins (varices, hemorrhoids, phlebitis, etc.) . .	-	3	-	1	1	-	-	-	1	17	-	2	1	16	1	10	3	1	1	-
Diseases of the lymphatic system (lymphangitis, etc.) . . . . .	-	-	-	-	5	3	1	-	3	80	3	10	1	49	2	11	4	8	2	-
Hemorrhage without determined cause; other diseases of the circulatory system . . . . .	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-
<b>Diseases of the Respiratory System:</b>																				
Diseases of the nasal fossae and their adnexa:																				
Diseases of the nasal fossae . . .	-	-	-	-	-	-	-	-	-	14	-	1	1	2	-	1	-	-	-	1
Others . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	-	-	1	-	-
Diseases of the larynx (except tuber- culosis and cancer) . . . . .	-	1	1	-	-	-	-	1	-	-	-	-	-	2	-	-	-	1	-	-
Bronchitis:																				
Acute . . . . .	2	27	-	9	2	5	-	1	4	149	-	4	2	13	1	4	1	13	4	-
Chronic . . . . .	-	4	-	-	9	7	-	-	-	13	-	1	-	2	-	1	-	1	1	-
Not otherwise defined (under 5 years of age) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Not otherwise defined (5 years and over) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	4	-	-	-	-
Bronchopneumonia (including capillary bronchitis):																				
Bronchopneumonia . . . . .	1	15	-	16	-	1	-	-	-	4	-	13	-	7	-	10	-	1	1	-
Capillary bronchitis . . . . .	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-

## REATED IN HOSPITALS—Continued

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
-	-	-	-	-	14	-	2	3	120	5	11	4	34	1	29	8	173	6	47	234	-	-	-	-
9	-	1	-	2	10	-	4	-	4	-	5	-	53	-	6	3*	116*	1	21	141*	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	-	-	-	-
-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	2	3	-	1	6	-	-	-	-
6	-	2	-	-	2	-	-	1	15	-	10	-	29	1	2	6	125	2	24	157	-	-	-	-
5	-	4	-	-	2	1	-	-	13	1	3	2	33	-	-	8	87	3*	16	114*	-	-	-	-
-	-	-	-	-	1	-	-	-	3	-	1	-	3	-	-	-	9	-	1	10	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	2	-	1	3	-	1	-	-
2	-	1	-	-	-	1	1	-	2	-	-	-	2	-	-	-	7	1	2	10	-	3	-	1
1	-	1	-	-	-	-	-	-	-	-	1	-	3	-	1	-	7	-	5	12	-	3	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	2	-	3	-	-	-	-
1	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4	1	3	8	-	-	-	-
16	-	6	-	-	4	-	2	-	2	-	6	-	5	-	3	-	60	2	31	93	-	16	-	9
14	-	13	-	-	11	-	3	-	1	-	3	-	2	-	1	3	64	2	45	114	-	12	-	8
4	-	1	-	-	3	-	-	-	1	-	1	-	1	-	-	-	12	-	2	14	-	3	-	-
3	-	1	-	-	2	-	2	-	2	-	1	-	1	1	2	1	25	2	12	40	-	2	1	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	2	4	-	1	-	1
1	5	-	3	-	2	1	1	3	1	1	-	-	2	-	-	10	48*	4	22	84*	-	-	-	-
2	19	-	3	1	12	1	4	3	45	-	5	2	15	-	5	21	231	9	40	301	-	-	-	-
-	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-	3	1	2	6	-	-	-	-
5	-	1	1	3	1	2	2	6	-	3	1	16	-	8	5	46	2	16	69	-	-	-	-	
4	-	2	1	3	-	1	-	-	-	-	-	4	-	5	4	15	1	8	28	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	5	2	2	9	-	-	-	-
34	1	11	5	46	2	17	10	72	-	37	13	130	1	33	40	490*	9	129	668*	-	-	-	-	
-	-	1	-	2	-	3	1	2	-	2	1	7	-	2	11	38	1	10	60	-	-	-	-	
-	-	1	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	7	7	-	-	-	1	
-	-	-	-	-	-	-	-	-	-	-	2	25	-	2	2	41	-	6	49	-	-	-	-	
1	-	2	-	1	-	11	1	9	4	5	-	4	-	13	2	43	5	71	121	1	10	-	20	
-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	1	2	-	3	6	-	1	-	-	

CLASSIFICATION OF DISEASES

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.		Emp.		Non- Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>Diseases of the Respiratory System—Continued</b>																				
Pneumonia:																				
Lobar . . . . .	-	2	-	-	2	19	-	1	-	38	1	2	-	17	1	11	-	38	-	2
Not otherwise specified . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	8	-	2	-	-
Pleurisy:																				
Pleurisy . . . . .	-	2	-	1	2	1	-	-	1	34	-	2	1	7	-	-	1	3	2	-
Empyema of thoracic cavity . . . . .	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
Congestion or parenchymatous hemorrhage of the lung . . . . .																				
Gangrene of the lung . . . . .	-	-	-	-	-	-	-	-	-	3	-	-	-	1	-	-	-	-	-	-
Asthma . . . . .	1	5	-	5	-	1	-	1	-	13	-	4	1	14	-	6	-	5	2	2
Emphysema of the lung . . . . .	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of the respiratory system (tuberculosis excepted):																				
Chronic interstitial pneumonia (including occupational diseases of the lungs) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of the mediastinum . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
<b>Diseases of the Digestive System:</b>																				
Diseases of the mouth and adnexa:																				
Diseases of the teeth and gums . . . . .	-	16	-	1	1	-	-	1	2	20	-	2	1	9	-	1	2	15	9	-
Other diseases of the buccal cavity and adnexa . . . . .	-	7	-	1	-	2	-	-	-	9	-	3	-	3	-	2	-	1	-	-
Diseases of the pharynx and tonsils (including adenoids):																				
Streptococcic sore throat . . . . .	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Ludwig's angina . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Tonsillitis . . . . .	3	8	2	7	-	-	-	-	1	24	1	15	11	13	-	15	2	7	6	9
Adenoids . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Others . . . . .	-	-	-	-	1	-	-	-	1	10	-	2	-	2	-	-	1	-	-	1
Diseases of the esophagus . . . . .																				
Ulcer of the stomach and duodenum:																				
Ulcer of the stomach . . . . .	-	1	-	-	-	-	-	-	-	1	-	-	1	3	-	1	1	2	1	4
Ulcer of the duodenum . . . . .	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	3	-	-	1
Other diseases of the stomach (cancer excepted):																				
Indigestion . . . . .	8	28	1	18	2	2	-	-	6	7	1	-	1	11	1	6	17	28	13	28
Gastritis . . . . .	3	5	-	1	3	-	-	2	1	2	-	1	-	3	-	-	1	-	-	1
Stricture or stenosis of pylorus . . . . .	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Others . . . . .	-	2	-	-	-	1	-	-	-	-	-	-	1	8	-	-	-	-	-	1
Diarrhea and enteritis (under 2 years of age) . . . . .																				
Diarrhea and enteritis (2 years and over) . . . . .	2	4	2	4	2	6	-	1	5	60	-	12	-	18	-	6	5	7	9	4
Ankylostomiasis . . . . .	-	30	1	2	1	46	-	5	1	79	-	2	1	69	-	17	-	87	1	70
Diseases due to other intestinal parasites:																				
Cestodes (hydatids of the liver excepted) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trematodes . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Filariasis . . . . .	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-
Ascariasis . . . . .	-	2	-	-	-	5	-	-	-	2	-	-	1	9	1	2	-	23	-	12
Trichocephalus . . . . .	-	13	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1	6	1	7
Nematodes not specified . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parasites not specified . . . . .	-	1	-	-	-	-	-	-	6	150	-	24	1	8	-	1	-	2	-	1
Appendicitis and typhlitis . . . . .	2	13	2	53	1	-	1	1	1	5	2	3	1	2	1	5	4	2	3	4
Hernia, intestinal obstruction:																				
Hernia . . . . .	-	11	-	3	-	4	-	-	-	60	2	7	3	17	-	4	-	13	4	8
Intestinal obstruction . . . . .	-	-	-	1	-	-	-	-	-	2	-	-	-	2	-	2	-	1	-	-



## REATED IN HOSPITALS—Continued

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
-	9	-	5	1	14	-	7	1	19	2	17	-	69	-	20	4	225	4	91	324	-	64	2	29
-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-	-	7	-	11	18	-	2	-	7
1	5	-	2	-	8	-	6	1	31	1	-	-	15	-	3	7	107*	3	19	136*	-	-	-	-
-	-	-	-	-	1	-	2	-	1	-	-	-	-	-	1	1	4	-	3	8	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4	-	1	5	-	1	-	-
1	3	-	3	-	12	-	6	4	3	-	3	1	1	-	7	8	1	2	37	1	1	-	1	-
-	-	-	-	-	3	-	-	1	-	-	1	-	-	-	-	2	3	-	1	6	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	4	-	1	-	1	-	-	-	-	-	-	-	8	-	1	9	-	1	-	1
1	7	-	2	3	17	-	8	2	18	-	3	-	23	-	11	12	125	9	32	178	-	-	-	-
-	2	1	-	1	5	1	3	-	1	1	-	1	-	-	-	2	30	3	10	45	-	-	-	1
-	-	-	-	-	-	-	-	-	1	-	-	-	2	1	-	-	4	1	2	7	-	-	-	-
-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	2	1	-	3	-	1	-	-
4	13	3	18	5	10	4	42	5	10	7	16	1	4	-	3	32	90*	23	125	270*	-	-	-	-
1	4	-	4	-	1	-	-	-	-	-	1	-	-	-	-	-	-	2	1	3	-	-	-	-
-	-	-	-	-	-	-	1	-	-	-	-	-	4	1	2	4	21	1	9	35	-	1	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-
1	1	-	2	-	7	-	2	-	-	-	-	-	-	1	-	3	15	2	7	27	-	3	1	-
-	-	-	-	1	10	-	1	-	-	1	-	-	-	-	-	6	10	2*	3	21*	-	1	-	-
-	-	-	-	2	7	-	3	-	16	1	8	11	11	-	10	47	110	17	73	247	-	-	-	-
-	12	-	1	-	9	-	-	-	1	-	4	1	3	1	1	9	35	1	11	56	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
-	-	-	-	1	3	2	1	1	5	2	7	-	4	-	2	3	23	4	11	41	-	2	-	-
-	-	-	-	-	-	1	4	-	-	2	12	-	-	-	9	-	-	3	57	60	-	-	-	8
5	6	-	1	3	16	-	10	3	24	3	8	12	22	1	3	38*	163	17*	49	267*	-	2	-	-
2	28	-	10	-	5	-	-	5	23	-	9	3	33	-	30	13	400	2	151	566	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	-	-	3	-	1	4	-	-	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	1	1	4	-	-	-	-
-	3	-	5	-	-	-	-	2	6	2	38	1	1	-	17	4	51	3	74	132	-	-	-	-
-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	20	1	11	33	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	5	5	-	-	-	-
-	1	-	5	3	8	2	14	-	1	-	1	-	2	-	4	10	173	2	50	235	-	-	-	-
3	6	2	7	3	11	3	37	2	3	1	2	1	6	-	-	18	48	15	112	193	-	3	-	2
13	-	6	3	32	-	6	1	13	2	13	-	-	13	-	5	8	177*	8	49	242*	-	1	-	1
-	-	-	1	3	-	1	1	-	-	-	1	-	-	-	2	2	8	-	7	17	-	5	-	3

## CLASSIFICATION OF DISEASES

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>Diseases of the Digestive System</b>																				
—Continued																				
Other diseases of the intestines:																				
Diseases of the anus and stercoral fistulae . . . . .	-	-	-	1	1	3	-	1	-	12	3	2	-	5	-	5	-	2	1	-
Other diseases of the intestines . . . . .	1	3	-	-	-	2	-	-	3	17	-	8	2	18	1	4	-	-	-	-
Acute yellow atrophy of the liver . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydatid tumor of the liver . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cirrhosis of the liver:																				
Returned as alcoholic . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
Not returned as alcoholic . . . . .	-	-	-	-	-	-	-	-	-	22	-	1	-	4	-	1	-	1	-	-
Biliary calculi . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Other diseases of the liver:																				
Abscess of the liver, amebic . . . . .	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	1	-	-	-	-
Other diseases of the liver . . . . .	-	1	-	-	-	5	-	-	-	38	2	8	6	47	3	20	1	1	2	-
Diseases of the pancreas (except cancer) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peritonitis of unstated cause . . . . .	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	3	-	-	-	-
Other diseases of the digestive system (cancer and tuberculosis excepted) . . . . .	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<b>Non-Venereal Diseases of the Genitourinary System and Its Adnexa:</b>																				
Acute nephritis (including unspecified under 10 years of age) . . . . .																				
Chronic nephritis (including unspecified over 10 years of age) . . . . .	-	11	-	5	1	1	-	1	-	36	-	4	-	24	1	17	2	4	3	-
Chyluria . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of the kidneys and their adnexa (diseases of the kidney in pregnancy not included) . . . . .																				
Calculi of the urinary passages . . . . .	2	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-
Diseases of the bladder (except tumors) . . . . .	2	5	-	3	-	5	-	-	2	7	-	9	-	19	-	5	-	-	-	-
Diseases of the urethra, urinary abscess, etc.:																				
Stricture of the urethra . . . . .	-	4	-	2	-	1	-	-	-	9	-	1	-	7	-	5	-	5	-	-
Others . . . . .	-	1	-	-	-	3	-	-	-	3	-	-	-	6	-	2	-	-	-	-
Diseases of the prostate (except tumors) . . . . .	-	6	-	-	-	-	-	-	1	9	-	2	-	2	-	2	-	-	1	-
Non-venereal diseases of the male genital organs . . . . .	2	17	-	3	3	1	-	-	3	29	1	7	-	16	-	8	2	3	2	-
Cysts and other benign tumors of the ovary . . . . .	-	-	1	9	-	-	-	-	-	1	-	3	-	-	-	1	-	-	1	-
Salpingitis or pelvic abscess . . . . .	-	-	-	5	-	-	-	4	1	4	-	29	-	3	-	7	-	3	-	-
Benign tumors of the uterus . . . . .	1	-	-	1	-	-	-	-	-	1	-	1	-	-	-	1	-	-	1	-
Non-puerperal uterine hemorrhage . . . . .	-	1	-	4	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-
Metritis . . . . .	-	-	-	6	-	-	-	-	-	1	-	3	-	3	-	11	-	-	-	-
Other diseases of the female genital organs.																				
Non-puerperal diseases of the breast (cancer excepted) . . . . .	-	-	-	1	-	-	-	-	-	4	2	22	-	2	1	5	-	1	4	-
<b>The Puerperal State:</b>																				
Accidents of pregnancy:																				
Abortion . . . . .	-	-	-	21	-	-	-	3	-	1	1	6	-	3	-	12	-	1	-	-
Ectopic gestation . . . . .	-	-	-	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
Other accidents of pregnancy . . . . .	-	-	-	14	-	-	-	-	-	2	-	9	-	2	-	12	-	4	6	-
Puerperal hemorrhage . . . . .	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-

## TREATED IN HOSPITALS—Continued

Panama Division			Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
2	-	2	2	6	-	2	-	4	-	1	1	6	1	3	4	40	5	17	66	-	1	-	-
9	-	9	-	-	-	1	-	-	-	-	3	5	-	1	13*	54	1	25	93*	-	2	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	2	4	-	1	-	1
-	-	-	-	1	-	-	-	1	-	1	-	2	-	1	-	31	-	4	35	-	5	-	1
2	-	1	-	-	-	-	-	-	-	1	-	1	-	3	-	3	-	7	10	-	-	-	-
1	-	-	-	1	-	-	-	3	-	-	-	-	-	1	1*	7	1	2	11*	-	-	-	-
-	-	3	-	1	-	1	2	34	2	5	-	19	1	1	9	147*	10	40	206*	-	4	-	4
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	1	-	-
1	-	2	-	-	-	1	-	1	-	1	-	5	-	1	-	9	1	8	18	-	1	1	6
6	-	3	-	2	-	-	2	2	1	2	1	-	-	2	3	11	2	10	26	-	-	1	-
1	-	1	-	-	-	7	1	15	-	5	-	1	-	3	1	32	-	22	55	-	2	-	2
8	-	2	2	7	-	2	-	11	1	-	1	3	1	3	6	106*	6	42	160*	2	16*	2	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	3	1	5	1	5	1	8	2	7	-	2	-	1	8	103	6	50	167	-	1	-	3
1	-	-	-	1	1	4	-	-	-	4	-	-	1	-	2	3	5*	9	19*	-	1	-	-
6	-	1	3	10	2	16	-	-	1	5	-	3	1	7	8	55	4	47	114	-	-	-	-
17	-	4	-	8	-	3	-	-	-	-	-	1	-	4	-	52	-	23	75	-	1	-	2
8	-	-	1	6	-	1	1	1	-	2	-	-	-	-	2	28	-	6	36	-	-	-	1
12	-	-	-	3	1	1	-	-	-	-	-	1	-	-	2	33	2	6	43	-	2	-	-
11	-	5	2	27	1	6	-	11	-	3	-	9	-	3	13	124	4	37	178	-	-	-	-
1	-	4	-	1	-	6	-	-	-	1	-	-	-	-	-	3	2	25	30	-	-	-	1
12	-	18	1	1	-	21	-	-	-	6	-	1	-	21	2	24	-	112	138	-	-	-	1
1	-	3	-	-	-	7	-	-	-	7	-	-	-	2	1	3*	1	22	27*	-	-	-	-
-	-	-	-	-	-	-	-	1	-	1	-	-	-	4	-	3	-	11	14	-	-	-	-
-	-	1	-	-	-	-	-	1	3	17	-	-	-	2	-	5	4*	41	50*	-	-	-	-
16	4	24	-	1	8	38	-	6	2	35	-	1	1	17	1	31	23	157	212	-	-	-	-
1	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	5	6	-	-	-	-
2	1	11	-	-	2	14	-	2	4	11	-	1	1	8	-	10	9	96	115	-	-	-	1
-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	1	1	-	5	7	1	1	-	-
-	-	2	-	-	1	8	-	-	1	16	-	-	1	10	-	8	9	87	104	-	-	-	2
-	-	-	-	-	-	1	-	-	-	-	-	1	-	2	-	1	-	6	7	-	-	-	2



## CLASSIFICATION OF DISEASE

	Banes Division		Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.	
	T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.		T. O.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>The Puerperal State—Continued</b>																		
Other accidents of childbirth:																		
Cesarian section . . . . .	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Other surgical operations and instrumental delivery . . . . .	-	-	-	11	-	-	-	-	-	1	-	4	-	-	-	2	-	-
Others . . . . .	-	-	-	2	-	-	-	-	-	1	5	-	-	-	4	-	1	-
Phlegmasia alba dolens, puerperal embolism, etc. . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Puerperal septicemia . . . . .	-	-	-	2	-	-	-	-	-	1	-	4	-	-	-	5	-	-
Puerperal albuminuria or convulsions . . . . .	-	-	-	-	-	-	-	-	-	1	-	2	-	1	-	2	-	-
Childbirth (without other explanation) . . . . .	-	-	6	35	-	-	-	11	-	1	6	40	-	-	1	42	-	9
Puerperal diseases of the breast . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Diseases of the Skin and of the Cellular Tissue:</b>																		
Gangrene . . . . .	-	1	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
Boil, carbuncle, furuncle . . . . .	1	3	-	3	2	3	-	-	4	48	2	5	1	17	1	4	8	11
Phlegmon, acute abscess . . . . .	5	63	3	13	3	4	-	-	2	147	2	23	-	29	-	16	4	44
Tinea and alopecia . . . . .	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-
Pruritis . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Other diseases of the skin and its adnexa:																		
Trichophytosis . . . . .	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Scabies . . . . .	1	4	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	2
Chiggers (pulex penetrans) . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red bug . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pemphigus contagiosus . . . . .	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Mycetoma . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground itch . . . . .	-	-	-	-	-	-	-	-	-	1	-	-	1	2	-	-	-	2
Filaria medinensis . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Elephantiasis . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
Myiasis of skin . . . . .	-	1	-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-
Dhobie itch . . . . .	1	-	-	-	-	1	-	-	1	11	-	1	1	-	-	-	2	6
Prickly heat . . . . .	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	1	2
Ulcer of the skin . . . . .	1	16	-	4	1	5	-	5	1	90	1	1	-	78	-	41	4	37
Ainhum . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ulcerating granuloma of the pudenda . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Impetigo contagiosa . . . . .	-	4	-	-	-	-	-	-	-	9	-	-	1	2	-	3	-	-
Urticaria . . . . .	1	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-
Other diseases of the skin and adnexa . . . . .	4	16	-	3	2	8	-	-	1	62	1	5	3	50	4	27	2	6
<b>Diseases of the Bones and of the Organs of Locomotion:</b>																		
Diseases of the bones (tuberculosis excepted):																		
Diseases of the joints (tuberculosis and rheumatism excepted) . . . . .	1	-	-	-	2	5	-	1	2	27	-	3	-	9	1	2	-	-
Other diseases of the bones or organs of locomotion . . . . .	-	-	-	-	1	-	-	-	1	63	-	1	-	12	-	2	-	-
<b>Malformations:</b>																		
Congenital malformations (stillbirths excepted):																		
Hydrocephalus . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malformations of heart . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-

## TREATED IN HOSPITALS—Continued

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
-	-	-	1	-	-	-	2	-	-	-	-	1	-	-	-	1	-	-	4	5	-	-	-	-
-	-	-	1	-	-	-	5	-	-	2	11	-	-	-	2	-	1	2	36	39	-	-	-	-
-	-	-	3	-	-	-	4	-	-	1	9	-	-	-	4	-	1	2	32	35	-	-	-	5
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	13	14	-	-	-	4
-	-	-	3	-	-	-	4	-	-	-	1	-	-	-	1	-	2	-	13	15	-	-	-	7
-	2	4	26	-	-	4	26	-	3	11	109	-	1	-	54	-	8	41	349	398	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-
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## CLASSIFICATION OF DISEASES

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>Diseases of Early Infancy:</b>																				
Congenital debility, icterus and sclerema:																				
Marasmus . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Inanition . . . . .	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Icterus . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sclerema . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Premature birth, or consequence of labor:																				
Premature birth . . . . .	-	-	-	1	-	-	-	2	-	-	-	2	-	-	-	1	-	-	-	-
Injury at birth . . . . .	-	-	-	1	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Other diseases peculiar to early infancy:																				
Asphyxia neonatorum . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atalectasis . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Umbilical infection . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Umbilical hemorrhage . . . . .	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lack of care . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Old Age:</b>																				
Old age . . . . .	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	2	-	-	-	1
<b>External Causes:</b>																				
Suicide . . . . .	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poisoning by food . . . . .	-	-	-	-	-	-	-	-	3	3	-	-	3	1	-	-	-	1	-	-
Snake bite . . . . .	-	-	-	-	1	4	-	-	-	1	-	-	-	10	-	3	-	-	-	-
Poisoning by venomous animals . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Other acute poisonings . . . . .	-	-	-	1	-	-	2	-	1	-	-	-	-	3	-	5	-	-	-	-
Burns and scalds . . . . .	1	9	-	4	-	-	1	-	3	3	-	1	1	5	-	1	-	3	-	-
Mechanical suffocation . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Absorption of irrespirable or poisonous gas . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Accidental drowning . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Injury by firearms . . . . .	-	-	1	3	2	3	-	1	-	10	2	10	-	7	-	14	-	3	-	-
Injury by cutting or piercing instruments . . . . .	7	365	-	10	2	15	-	4	-	122	-	5	-	135	1	42	1	69	3	5
Injury by falls . . . . .	1	17	-	2	3	15	-	3	-	2	-	-	2	49	2	14	6	35	3	1
Traumatism by machines . . . . .	2	11	-	-	-	4	-	-	-	2	-	-	-	1	-	-	-	3	-	-
Traumatism by other crushing (vehicles, railways, landslides, etc.) . . . . .	5	24	-	3	2	24	-	3	1	13	1	4	1	25	-	6	9	30	4	2
Injuries by animals (not poisoning) . . . . .	-	2	-	1	-	-	-	-	1	10	-	-	1	5	-	-	-	8	-	-
Overexertion . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Starvation . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Effects of heat . . . . .	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lightning . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electricity . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Homicide by firearms . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Homicide by cutting or piercing instruments . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Homicide by other means . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Infanticide . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dislocations . . . . .	1	4	-	-	-	-	-	-	-	7	-	-	1	1	-	1	-	1	-	-
Sprains . . . . .	2	7	-	1	2	1	-	-	1	2	-	1	-	3	-	-	3	-	-	-
Fractures (cause not specified) . . . . .	-	12	1	5	-	-	-	-	1	20	-	13	-	8	-	8	-	-	-	1
<b>Other external violence:</b>																				
Criminal abortion . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Explosions . . . . .	-	1	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-
Salvarsan injection . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	31	-	-	-	-	-	-
Other medicaments (injections) . . . . .	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Other external violence . . . . .	-	-	-	-	-	-	-	-	4	123	1	12	2	115	-	34	-	1	-	-



TREATED IN HOSPITALS—Continued

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
-	-	-	-	-	-	-	1	-	-	-	3	-	-	-	-	-	-	7	7	-	-	-	3	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	2	4	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	4	-	-	-	1	-	-	-	-	-	-	-	6	6	-	-	-	1
-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	6	-	-	-	14	14	-	-	-	8
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	7	7	-	-	-	2
-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	2	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	-	-	-
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	3	3	-	-	-	1
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	3	3	-	-	-	1
-	-	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	3	1	5	9	-	1	1	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	3	-	1	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6	5	-	1	12	-	-	-	-
-	8	-	2	-	-	-	-	-	-	1	-	-	-	-	1	1	23	-	7	31	-	1	-	1
-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	1	-	6	-	1	7	-	-	-	-
-	2	-	-	-	-	-	1	-	1	-	1	-	2	-	2	1	8	-	12	21	-	-	-	1
-	3	-	1	1	7	-	1	-	5	-	4	2	6	1	2	10*	41	2	19	72*	-	-	-	-
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	3	-	8	-	4	1	5	3	22	1	9	-	12	1	10	5	64	6	65	140	1	7	2	6
69	-	11	10	211	2	14	2	132	2	22	2	166	1	23	24	1284	9	188	1505	-	7	-	-	1
5	-	2	-	-	-	-	1	49	-	7	3	61	3	4	16	234*	8	51	309*	-	2	-	-	1
1	-	-	-	-	-	-	-	11	-	1	-	8	1	-	3*	41	1	1	46*	-	-	-	-	-
3	6	-	2	-	5	-	3	6	45	2	6	-	31	-	3	27	203	7	51	288	-	8	1	9
-	-	-	-	-	-	-	-	-	3	-	-	-	11	-	2	2	39	-	9	50	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	3	1	-	4	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	1	1	1	-	3	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	1	-	2	3	-	1	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	1	3	-	2	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-
-	1	-	1	-	4	-	2	-	-	-	1	1	2	-	1	3	20	-	6	29	-	1	-	-
1	2	1	-	2	1	-	-	6	8	1	2	1	2	1	-	18	26	3	5	52	-	-	-	-
1	6	1	3	4	28	3	9	-	15	2	9	1	13	1	5	7	102	9	54	172	-	4	1	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	2	5	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	32	-	3	35	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
1	63	-	12	7	130	3	7	2	8	1	1	1	5	1	2	17	445	6	69	537	-	2	1	2

CLASSIFICATION OF DISEASE

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.		O.		T.		O.		T.		O.		T.		O.		T.		O.	
III-Defined Diseases:																				
Sea sickness . . . . .	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Ill-defined organic diseases . . . . .	-	-	-	-	-	-	-	-	-	7	1	3	-	-	-	1	-	-	-	-
Sudden death . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
†No disease; malingering . . . . .	1	9	6	46	2	9	-	12	3	40	1	61	-	-	2	56	3	8	14	2
Infections of undetermined origin . . . . .	2	2	-	-	-	3	-	-	-	2	-	1	-	6	-	3	-	-	-	-
TOTALS . . . . .	105	1224	34	530	249	736	9	185	153	3650	71	642	133	2389	69	1198	144	1206	226	109

\* Including Jamaica Division.

† NOTE. — Under “No disease; malingering” are included (a) infants born in the Hospital, nursling babies, well mother who entered the Hospital with ill babies, and babies who were admitted with ill mothers; and (b) patients who were found to be without physical ailment of any kind, or who were malingering.

This table gives only *cases* treated in our Hospitals and does not show the *number of treatments*.

TREATED IN HOSPITALS—*Concluded*

Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-totals*				Total*	Deaths in Hospitals*			
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.			Emp.		Non-Emp.	
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.		T.	O.	T.	O.
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	
-	-	1	-	-	-	-	-	-	6	1	4	-	2	-	1	-	15	2	10	27	-	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9	2	55	-	8	82	5	51	9	61	28	183	2	23	2	97	28	241	60	590	919	-	-	-	-
-	-	1	-	-	1	1	6	2	30	2	14	5	11	1	2	9	57*	4	27	97*	-	4	-	10
1047	28	607		121	1374	69	701	196	3178	184	1264	180	2634	67	1007	1375*	17511*	769*	7234*	26839*	12	394*	25*	366



CLASSIFICATION OF TREATMENT

*Note: This table shows the number of treatments administered at the Hospital*

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>Epidemic, Endemic or Infectious Diseases:</b>																				
Malaria or cachexia (No. 5).	6	1450	-	1594	1622	8782	314	8322	37	2494	11	193	63	894	7	309	248	1097	158	48
Influenza (No. 11) . . . .	107	781	43	924	35	112	10	14	16	2198	4	91	43	810	8	85	50	80	14	3
Dysentery (No. 16) . . . .	1	23	-	22	13	63	-	25	9	1052	11	170	1	55	1	18	-	-	-	-
Venereal infections (Nos. 38 to 40, incl.) . . . .	6	215	-	50	144	597	5	163	2	1399	6	192	14	738	7	97	-	205	-	8
Other endemic or infectious diseases (Nos. 1 to 42, incl., excepting Nos. 5, 11, 16, and 38 to 40, incl.) . . . . .	1	56	-	267	-	107	-	52	-	142	2	66	14	105	6	79	-	-	-	-
<b>General Diseases Not Included Above:</b>																				
Cancer (Nos. 43 to 49, incl.) .	-	5	-	1	-	-	-	-	-	-	-	9	-	14	-	-	-	-	-	-
Benign tumors, and tumors not returned as malignant (No. 50) . . . . .	9	32	-	41	-	-	-	-	-	37	1	19	2	3	-	-	-	-	-	-
Rheumatism or gout (Nos. 51 and 52) . . . . .	13	381	1	114	-	37	-	1	16	1445	4	64	48	807	6	55	62	222	30	8
Anemia, chlorosis (No. 58) .	20	325	24	721	-	2	-	1	1	291	4	61	13	144	12	58	-	-	-	-
Other general diseases (Nos. 43 to 60, incl., excepting Nos. 43 to 52, incl., and No. 58) .	-	34	9	64	5	32	2	1	-	40	13	88	6	13	1	18	-	-	-	-
<b>Diseases of the Nervous System and of the Organs of Special Sense:</b>																				
Diseases of the nervous system (Nos. 70 to 84, incl.) . . . . .	10	160	2	268	-	17	-	9	2	671	11	104	12	164	8	40	-	-	-	-
Diseases of the organs of vision and adnexa (No. 85) . . . . .	37	296	2	197	10	73	-	5	10	643	2	39	21	213	2	18	19	55	5	1
Diseases of the organs of hearing and the mastoid process (No. 86) .	4	46	-	39	16	56	-	3	2	103	1	57	25	70	4	12	5	33	2	
<b>Diseases of the Circulatory System:</b>																				
Organic diseases of the heart (Nos. 87 to 90, incl.) . . . . .	4	22	3	21	-	8	-	-	-	25	-	15	3	61	-	39	-	-	-	-
Other diseases of the circulatory system (Nos. 87 to 96, incl., excepting Nos. 87 to 90, incl.)	-	74	-	74	37	59	18	2	-	199	7	59	11	124	3	38	-	-	-	-
<b>Diseases of the Respiratory System:</b>																				
Bronchitis (No. 99) . . . .	89	707	62	686	104	403	19	80	10	1515	9	243	20	534	9	106	81	193	37	1
Pneumonia and pleurisy (Nos. 100 to 102, incl.) .	-	68	-	82	-	4	-	-	-	25	1	13	4	91	-	7	-	-	-	-
Other diseases of the respiratory system (Nos. 97 to 107, incl., excepting Nos. 99 to 102, incl.) .	5	72	23	134	-	-	-	-	1	565	3	57	1	183	2	33	-	-	-	-
<b>Diseases of the Digestive System:</b>																				
Diseases of the mouth and adnexa (No. 108) . . . .	26	252	21	235	35	158	-	49	6	505	6	57	4	133	7	22	16	73	3	
Diarrhea and enteritis (Nos. 113 and 114) . .	16	102	21	672	50	288	1	30	5	525	11	225	6	87	6	67	-	3	2	
Ankylostomiasis (No. 115) .	-	30	-	32	17	447	7	125	-	199	-	10	-	67	1	18	-	-	-	-

## N HOSPITAL DISPENSARIES

*Dispensaries (by qualified physicians), and does not record the number of cases*

Jamaica Division				Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total
Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		
T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	
55	1772	4	306	3	540	1	531	23	752	5	1061	480	2680	513	1023	39	402	9	228	2576	20863	1022	14020	38481
78	585	33	84	22	75	2	30	72	602	22	998	182	905	219	374	16	116	4	54	621	6264	359	2691	9935
-	21	-	9	-	4	-	5	-	8	-	4	23	312	31	118	5	13	-	18	52	1551	43	389	2035
1	236	14	11	-	2487	11	820	6	230	-	76	118	1455	38	614	19	438	13	110	310	8000	94	2216	10620
8	109	6	26	-	16	-	63	1	50	5	356	2	42	-	15	-	5	16	81	26	632	35	1005	1698
-	-	-	-	-	-	-	4	-	-	3	5	-	-	-	-	-	-	-	4	-	19	3	23	45
-	1	1	1	-	12	-	2	-	-	-	1	-	-	-	-	1	36	1	8	12	121	3	72	208
-	172	8	2	3	122	5	26	8	173	4	103	-	-	-	-	1	15	1	9	151	3374	59	462	4046
13	127	24	35	2	12	-	16	2	28	3	173	-	-	-	-	1	12	-	12	52	941	67	1077	2137
3	11	8	14	-	1	-	11	14	134	16	109	103	537	98	239	-	5	-	6	131	807	147	550	1635
29	328	46	34	12	122	6	26	16	201	7	250	5	28	1	6	24	90	7	70	110	1781	88	807	2786
18	198	9	22	10	101	2	23	31	322	14	222	15	322	11	102	141	419	34	281	312	2642	81	935	3970
57	97	8	16	8	35	10	36	3	27	2	57	6	138	5	46	10	61	16	47	136	666	48	322	1172
-	25	4	1	1	129	-	87	-	36	1	64	7	70	5	15	1	10	-	17	16	386	13	259	674
10	106	6	26	5	74	-	65	3	25	1	57	61	399	55	155	-	7	4	12	127	1067	94	488	1776
-	7	1	3	10	96	1	55	105	212	28	365	1	31	2	7	139	489	36	305	559	4187	204	1963	6913
-	101	2	5	-	5	1	5	-	6	6	43	3	124	11	36	-	3	1	19	7	427	22	210	666
2	87	4	20	15	344	4	80	19	71	9	145	39	186	34	97	105	489	17	129	187	1997	96	695	2975
1	108	10	6	9	129	3	56	11	371	2	290	6	46	9	19	21	335	13	94	135	2110	74	835	3154
8	45	12	18	4	13	-	12	3	90	27	447	9	157	23	91	11	41	4	89	112	1351	107	1652	3222
-	14	-	2	-	14	-	44	-	8	-	5	31	535	43	201	-	-	-	10	48	1314	51	447	1860

## CLASSIFICATION OF TREATMENT

Note: This table shows the number of treatments administered at the Hospital

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division				Guatemala Division			
	Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.		Emp.		Non-Emp.	
	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.
<b>Diseases of the Digestive System—Continued</b>																				
Other diseases of the digestive system (Nos. 108 to 127, incl., excepting No. 108, and Nos. 113 to 115, incl.)	127	926	98	1295	129	693	19	67	52	3028	23	624	78	939	19	188	130	213	83	1
<b>Non-Venereal Diseases of the Genitourinary System and Its Adnexa:</b>																				
Nos. 128 to 142, incl. . . .	21	231	16	497	2	43	—	12	1	421	27	385	26	291	19	295	—	—	—	—
<b>The Puerperal State:</b>																				
Nos. 143 to 150, incl. . . .	—	—	4	216	—	—	—	1	—	—	1	14	—	3	2	17	—	—	—	—
<b>Diseases of the Skin and of the Cellular Tissue:</b>																				
Boil, carbuncle, furuncle (No. 152) . . . . .	30	332	2	214	138	590	20	57	12	246	8	40	9	191	2	30	—	—	—	—
Phlegmon, acute abscess (No. 153) . . . . .	27	948	9	365	89	382	3	57	4	590	7	169	6	120	—	40	3	61	10	—
Ground itch . . . . .	9	—	—	15	99	213	2	—	—	—	—	—	2	2	—	—	—	—	—	—
Ulcer of the skin. . . . .	5	525	10	221	99	1767	—	515	—	1482	2	85	12	427	1	47	9	454	4	11
Other diseases of the skin or cellular tissue, and adnexa (Nos. 151 to 154, incl., excepting Nos. 152 and 153, and "Ground itch" and "Ulcer of the skin") . .	94	563	45	634	560	1185	17	65	16	1390	12	196	47	613	9	103	109	—	40	—
<b>Diseases of the Bones and of the Organs of Locomotion:</b>																				
Nos. 155 to 158, incl. . . .	1	13	—	29	2	9	—	—	—	404	4	42	—	15	—	1	—	—	—	—
<b>Malformations:</b>																				
No. 159 . . . . .	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<b>Diseases of Early Infancy:</b>																				
Nos. 160 to 163, incl. . . .	—	—	—	65	—	—	—	2	—	—	—	1	—	—	—	10	—	—	—	—
<b>Old Age:</b>																				
No. 164 . . . . .	—	2	—	20	—	—	—	—	—	—	—	—	—	10	—	—	—	—	—	—
<b>External Causes:</b>																				
Injury by firearms (No. 183) . . . . .	—	11	—	—	—	1	—	—	—	10	—	—	—	—	—	2	—	9	—	—
Injury by cutting or piercing instruments, and by falls (Nos. 184 and 185).	220	7083	47	631	147	589	4	76	13	848	2	63	23	1387	6	105	—	112	—	—
Traumatism by machines and other means (Nos. 187 and 188) . . . . .	215	572	4	51	191	632	—	25	—	486	—	14	47	78	—	10	—	10	—	—
Dislocations, sprains, fractures (No. 201) . . . . .	12	124	—	50	6	42	5	2	—	14	—	12	—	58	3	12	—	—	—	—
Other external causes (Nos. 165 to 203, incl., excepting Nos. 183 to 185, incl., 187, 188, and 201) . . . . .	32	345	26	249	119	534	6	164	16	1035	8	19	11	488	1	62	17	219	16	3
<b>*Ill-Defined Diseases:</b>																				
*Nos. 204 and 205 . . . . .	128	1478	175	8568	26	443	49	490	—	347	5	120	51	171	53	341	—	—	—	—
<b>TOTALS . . . . .</b>	1275	18284	647	19358	3695	18368	501	10415	231	24374	206	3616	623	10103	205	2382	749	3039	404	112

NOTE: This table shows the number of treatments, and not the number of cases treated, in our Hospital Dispensaries. The universally by public-health and city and state health departments and organizations.

\* Under "Ill-defined Diseases" (Charts Nos. 204 and 205) some Divisions have included (a) persons who were found by medical examinations of prospective employees and of aliens who were prospective passengers aboard the steamships; (d) was obtained; (e) obstetrical patients who came for periodical examinations; and (f) persons who came to the dispensary for special foods for infants, and other similar articles.



HOSPITAL DISPENSARIES—*Concluded*

*Dispensaries (by qualified physicians), and does not record the number of cases*

Jamaica Division			Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				Semi-Totals				Total
Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.	Emp.		Non-Emp.			
O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.	T.	O.			
830	109	105	23	406	14	293	108	805	63	1339	53	582	55	210	165	706	42	338	975	9128	525	4613	15241
290	30	36	13	395	15	343	10	146	18	510	47	273	86	350	21	101	10	194	156	2191	221	2622	5190
14	-	-	-	1	-	2	-	3	2	103	-	-	-	-	-	1	-	19	-	22	9	372	403
131	2	28	16	57	1	12	6	70	4	24	78	453	60	201	49	100	26	67	343	2170	125	674	3312
137	18	22	1	39	1	68	59	492	25	453	128	637	112	335	93	349	42	237	417	3755	227	1751	6150
-	-	-	-	-	-	-	-	-	-	12	19	134	13	48	9	12	-	1	138	361	15	76	590
264	-	51	3	129	-	18	3	506	37	218	149	1005	118	491	2	143	3	34	283	6702	175	1796	8956
169	13	34	48	284	28	154	93	443	17	804	217	1151	194	627	193	573	196	223	1402	6371	571	2840	11184
51	4	2	2	59	1	25	-	23	-	29	-	-	-	-	28	275	4	57	37	849	13	185	1084
-	-	-	-	-	-	2	-	-	-	3	-	-	-	-	-	-	-	1	-	-	-	6	6
-	-	12	-	-	-	11	-	-	-	40	-	-	-	-	-	-	-	5	-	-	-	146	146
-	-	2	-	5	-	1	-	3	-	12	-	-	-	-	-	-	-	-	2	20	-	35	57
-	-	-	-	5	-	56	-	-	-	2	-	71	5	41	-	43	2	-	-	150	7	101	258
902	26	20	-	48	-	53	226	2789	38	529	52	931	48	428	17	474	17	90	710	15163	188	1996	18057
491	10	1	2	12	-	1	37	527	-	30	-	-	-	-	3	148	2	11	514	2956	16	143	3629
102	4	11	6	27	1	27	2	52	-	29	1	14	-	8	8	55	2	11	41	488	15	162	706
639	80	1932	47	470	11	84	210	1322	39	244	-	-	-	-	8	177	2	155	556	5229	189	2942	8916
110	76	355	607	3074	366	2881	15	206	2	297	51	152	21	65	428	795	176	1216	1314	6776	923	14333	23346
8280	572	3252	872	9342	484	6028	1086	10733	400	9509	1886	13370	1810	5962	1558	6938	700	4262	12568	122831	5929	65911	207239

Chart numbers used are taken from the "International List of Causes of Sickness and Death." These chart numbers are used

(a) without physical ailment of any kind, or who were malingering; (b) vaccinations against smallpox and typhoid; (c) laboratory examinations made upon request, with no physical examination of the individual from whom the specimen was obtained; (d) without any stated or ascertained symptoms or physical signs of disease, but who obtained medicines, surgical supplies,

## CONSOLIDATED

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.
<b>BONES, OPERATIONS ON:</b>								
Skull, fracture of . . . . .	1	-	-	-	-	-	-	-
Craniectomy, decompressive . . . . .	-	-	-	-	-	-	-	-
Craniectomy, exploratory . . . . .	-	-	-	-	-	-	-	-
Bone graft . . . . .	-	-	-	-	-	-	-	-
Fractures, simple . . . . .	3	12	5	5	3	-	34	13
Fractures, comminuted . . . . .	4	2	2	-	-	-	3	-
Fractures, compound . . . . .	3	3	9	6	-	-	7	-
Laminectomy . . . . .	-	-	-	-	-	-	1	-
Operations for reduction of fractures . . . . .	5	-	3	5	3	1	3	1
Osteotomy . . . . .	-	-	-	-	4	-	2	1
Osteectomy . . . . .	-	-	-	-	1	-	1	-
Resection of elbow . . . . .	-	1	-	-	-	-	-	-
Resection of shoulder . . . . .	-	-	-	-	-	-	-	-
Others . . . . .	-	-	-	-	17	-	2	-
<b>CHEST, OPERATIONS ON:</b>								
Breast abscess, incision of . . . . .	1	3	-	-	1	-	1	-
Breast, excision of . . . . .	-	-	-	-	-	-	11	1
Breast and axilla, excision of . . . . .	-	-	-	-	-	-	4	-
Thoracotomy . . . . .	-	-	-	-	2	-	-	-
Others . . . . .	-	-	-	-	9	-	-	-
<b>LAPAROTOMY:</b>								
Abdomen, penetrating wound of . . . . .	1	-	1	-	-	-	-	-
Abscess of liver, laparo-hepatotomy . . . . .	-	-	-	-	-	-	-	-
Abscess of liver, thoraco-hepatomy . . . . .	-	-	-	-	-	-	-	-
Appendectomy with local peritonitis . . . . .	61	-	2	-	12	-	5	-
Appendectomy with general peritonitis . . . . .	5	-	-	-	4	-	1	1
Cholecystectomy . . . . .	-	-	-	-	2	-	2	-
Cholecystotomy . . . . .	-	-	-	-	-	-	2	-
Colostomy . . . . .	-	-	-	-	-	-	-	-
Ectopic gestation . . . . .	-	-	-	-	-	-	-	-
Enterectomy . . . . .	-	-	-	-	1	-	-	-
Entero-enterostomy . . . . .	-	-	-	-	-	-	2	-
Enterorrhaphy . . . . .	-	-	-	-	-	-	-	-
Exploratory . . . . .	7	-	1	-	6	-	2	-
Gastro-enterostomy . . . . .	-	-	-	-	-	-	-	-
General peritonitis . . . . .	1	-	-	-	-	-	1	-
Hysterectomy supravaginal . . . . .	-	-	-	-	20	-	1	-
Hysterectomy vaginal . . . . .	-	-	-	-	-	-	-	-
Pan-hysterectomy . . . . .	1	-	-	-	-	-	-	-
Hystero-myomectomy . . . . .	-	-	-	-	2	-	-	-
Hysteropexy . . . . .	-	-	-	-	-	-	-	-
Hysteropexy with perineorrhaphy . . . . .	-	-	-	-	-	-	-	-
Intestinal obstruction . . . . .	-	-	-	-	1	-	1	-
Intussusception, treatment of . . . . .	-	-	-	-	-	-	1	-
Ovarian cystectomy . . . . .	2	-	-	-	6	-	1	-
Oophorectomy, complete . . . . .	6	-	-	-	-	-	-	-
Oophorectomy, partial . . . . .	-	-	-	-	-	-	-	-
Paracentesis abdominalis . . . . .	3	9	-	-	1	-	17	-
Partial resection of the stomach . . . . .	-	-	-	-	-	-	-	-
Salpingectomy . . . . .	5	-	-	-	4	-	2	-
Salpingo-oophorectomy . . . . .	-	-	-	-	12	-	1	-
Splenectomy . . . . .	-	-	-	-	-	-	-	-
Others . . . . .	-	-	1	-	12	-	3	-
<b>OBSTETRICAL:</b>								
Abortions . . . . .	9	5	2	1	6	-	2	-
Births, premature . . . . .	4	-	1	-	-	-	2	-
Births, normal . . . . .	41	-	10	-	49	-	28	-
Births, multiple . . . . .	1	-	-	-	-	-	-	-
Births, forceps operations . . . . .	4	-	-	-	5	-	3	-
Births, abnormal presentations . . . . .	-	-	-	-	2	-	-	-

GICAL REPORT

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Totals		Post-Operative Deaths
Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	
-	-	-	-	-	-	1	-	3	-	-	-	5	-	-
-	-	-	-	-	-	-	-	-	-	2	-	2	-	1
1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	-	-	4	-	-	47	17	23	-	19	2	136	53	-
-	-	-	-	-	-	-	-	6	-	1	-	16	2	-
-	-	-	1	-	-	1	-	7	-	3	-	30	10	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
1	-	-	1	5	-	-	-	1	-	5	-	26	8	1
1	-	-	-	-	-	10	-	-	-	1	-	18	1	-
-	-	-	-	-	-	1	-	1	-	-	-	4	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	1	-	-	-	1	-	-
1	-	-	-	1	-	3	-	-	-	1	-	25	-	2
-	-	-	-	-	-	-	1	1	-	-	1	4	5	-
-	-	-	-	-	-	1	-	-	-	-	-	11	1	-
1	-	-	-	-	-	3	-	2	-	2	-	5	-	-
-	-	-	-	1	-	1	-	2	-	8	1	10	-	3
-	-	-	-	-	-	-	-	-	-	-	-	21	1	-
-	-	-	-	-	-	-	-	2	-	1	-	5	-	1
1	-	-	-	-	-	-	-	1	-	-	-	2	-	-
1	-	-	-	12	-	91	-	11	-	4	-	209	-	1
1	-	-	-	2	-	6	-	-	-	1	-	20	1	8
2	-	-	-	1	-	10	-	-	-	4	-	21	-	2
-	-	-	-	-	-	2	-	-	-	1	-	5	-	1
-	-	-	-	2	-	-	-	-	-	-	-	2	-	1
-	-	-	-	-	-	1	-	1	-	-	-	2	-	-
-	-	-	-	-	-	-	-	1	-	-	-	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	2	-	1
-	-	-	-	-	-	4	-	2	-	1	-	7	-	1
-	-	-	-	9	-	4	-	1	-	3	-	33	-	11
1	-	-	-	2	-	6	-	-	-	-	-	9	-	2
2	-	-	-	1	-	-	-	1	-	-	-	6	-	2
1	-	1	-	1	-	7	-	1	-	1	-	33	-	1
-	-	-	-	-	-	5	-	-	-	-	-	5	-	-
-	-	-	-	5	-	7	-	-	-	-	-	13	-	-
-	-	-	-	-	-	-	-	3	-	1	-	6	-	-
-	-	-	-	3	-	3	-	2	-	1	-	10	-	-
-	-	-	-	-	-	-	-	1	-	2	-	4	-	-
-	-	-	-	-	-	-	-	-	-	-	-	3	-	1
-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
-	-	-	-	-	-	16	-	1	-	-	-	10	-	1
-	-	-	-	-	-	9	-	-	-	-	-	31	-	-
-	-	-	-	1	-	-	-	-	-	4	-	26	9	2
-	-	-	-	-	-	2	-	-	-	-	-	2	-	1
2	-	-	-	6	-	15	-	3	-	-	-	37	-	3
1	-	-	-	4	-	18	-	2	-	4	-	42	-	3
1	-	-	-	-	-	-	-	-	-	2	-	3	-	1
1	-	-	-	-	-	2	-	-	-	-	-	19	-	3
-	-	-	-	1	-	-	2	12	-	8	-	40	8	-
-	-	-	-	-	-	-	1	3	-	7	-	17	1	1
6	-	-	-	29	-	28	5	102	-	50	-	353	5	-
-	-	-	-	-	-	-	-	-	-	1	-	2	-	-
2	-	-	-	1	-	1	-	13	-	2	-	31	-	1
-	-	-	-	-	-	1	-	3	-	3	-	9	-	-



	CONSOLIDATED SURG							
	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.
OBSTETRICAL—Concluded:								
Births, versions . . . . .	3	—	—	—	6	—	2	—
Births, episiotomy . . . . .	—	—	—	—	—	—	1	—
Births, Cæsarian operations . . . . .	—	—	—	—	1	—	—	—
Repairs of perineum . . . . .	1	—	—	—	1	—	1	—
Others . . . . .	—	—	1	—	1	—	—	—
GENITOURINARY TRACT:								
Chancroid operations . . . . .	6	1	1	21	6	—	11	—
Circumcisions . . . . .	2	1	7	—	29	2	3	—
Curettagé uteri . . . . .	8	—	1	—	20	—	1	—
Cystotomy . . . . .	—	—	—	—	—	—	—	—
Epididymectomy . . . . .	—	—	—	—	1	—	—	—
Epididymotomy . . . . .	—	—	—	—	2	—	—	—
Hydrocele, single, radical cure . . . . .	5	—	—	—	5	—	6	—
Hydrocele, double, radical cure . . . . .	—	—	—	—	1	—	—	—
Nephrectomy . . . . .	—	—	—	—	—	—	—	—
Nephrotomy . . . . .	—	—	—	—	—	—	—	1
Orchidectomy . . . . .	—	—	—	—	1	—	1	—
Penis, operations on . . . . .	1	—	4	4	11	—	2	—
Perineorrhaphy . . . . .	1	1	—	—	8	—	—	—
Perinephritic abscess . . . . .	—	—	—	—	—	—	—	—
Prostatectomy . . . . .	—	—	—	—	1	—	1	—
Scrotum operations . . . . .	1	—	—	—	—	—	2	—
Trachelorrhaphy . . . . .	—	—	—	—	—	—	—	—
Vaginal puncture for pelvic cellulitis . . . . .	—	—	—	—	6	—	1	—
Vaginal operations . . . . .	1	—	—	—	19	—	—	—
Varicocele, radical cure . . . . .	—	—	—	—	2	—	—	—
Vasectomy . . . . .	—	—	—	—	1	—	—	—
Urethrotomy, internal . . . . .	2	—	—	—	1	—	—	—
Urethrotomy, external . . . . .	—	—	—	—	—	—	1	—
Others . . . . .	—	—	1	2	11	—	6	1
HERNIOTOMY:								
Femoral . . . . .	—	—	—	—	1	—	—	—
Inguinal, single . . . . .	13	—	—	—	57	—	13	1
Inguinal, double . . . . .	2	—	—	—	8	—	—	—
Strangulated . . . . .	2	—	2	—	3	—	—	—
Umbilical . . . . .	—	—	—	—	—	—	—	—
Ventral . . . . .	—	—	—	—	2	—	—	—
Others . . . . .	—	—	—	—	1	—	1	—
ADENECTOMY:								
Axillary . . . . .	—	—	—	2	—	—	—	—
Cervical . . . . .	1	—	—	2	—	—	1	—
Femoral . . . . .	—	—	1	—	3	2	—	—
Inguinal, single . . . . .	4	—	6	13	32	3	1	—
Inguinal, double . . . . .	—	—	—	—	1	—	1	—
AMPUTATIONS:								
Hand . . . . .	—	—	—	—	1	—	—	—
Forearm . . . . .	—	—	—	—	—	—	—	—
Arm . . . . .	1	—	—	—	2	—	1	—
Thigh . . . . .	—	—	—	—	1	—	3	—
Leg . . . . .	—	—	3	—	1	—	—	—
Foot . . . . .	—	—	—	—	—	—	1	—
Digits, multiple . . . . .	7	2	2	2	12	—	18	—
JOINTS, OPERATIONS ON:								
Arthrotomy . . . . .	—	—	2	—	—	—	—	—
Reduction of dislocation . . . . .	—	26	—	8	2	—	3	2
Others . . . . .	—	—	8	32	9	—	3	3

## AL REPORT—Continued

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Totals		Post Operative Deaths
Hosp.	Disp.	Hosp.	Disp.	Hosp.	Disp.	Hosp.	Disp.	Hosp.	Disp.	Hosp.	Disp.	Hosp.	Disp.	
-	-	-	-	-	-	5	-	2	-	-	-	18	-	1
-	-	-	-	-	-	-	-	6	-	-	-	7	-	-
-	-	-	-	2	-	5	-	-	-	-	-	8	-	3
-	-	-	-	-	-	-	-	-	-	2	-	5	-	-
-	-	-	-	4	-	10	-	1	-	2	-	19	-	1
1	-	-	-	-	-	-	-	19	13	6	2	50	37	-
5	-	-	-	5	-	12	-	10	1	5	-	78	4	-
-	-	-	-	2	-	32	-	8	-	2	-	74	-	-
-	-	-	-	5	-	2	-	1	-	3	-	11	-	2
-	-	-	-	-	-	1	-	-	-	-	-	2	-	-
-	-	-	-	-	-	-	-	2	-	-	-	4	-	-
1	-	-	6	3	-	9	-	4	-	-	-	33	6	-
-	-	-	-	-	-	4	-	-	-	-	-	5	-	-
-	-	-	-	1	-	1	-	-	-	-	-	2	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
-	-	-	-	1	-	5	-	-	-	-	-	8	-	-
-	-	-	-	6	-	-	-	5	-	1	-	30	4	-
-	-	-	-	1	-	9	-	2	-	-	-	21	1	-
-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
-	-	-	-	4	-	1	-	-	-	-	-	7	-	-
-	-	-	1	6	-	1	-	1	-	1	-	12	1	1
-	-	-	-	1	-	1	-	-	-	-	-	2	-	-
-	-	-	-	2	-	-	-	-	-	1	-	10	-	-
-	-	-	-	5	-	-	-	2	-	1	1	28	1	-
-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
1	-	-	6	-	-	-	-	9	-	6	8	19	14	-
2	-	-	1	1	-	5	-	-	-	-	-	9	1	2
-	-	-	-	-	-	5	-	1	-	12	2	36	5	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	13	-	30	-	10	-	2	-	15	-	-
1	-	-	-	-	-	5	-	21	-	11	-	178	1	-
1	-	-	-	-	-	2	-	1	-	3	-	20	-	1
-	-	-	-	1	-	1	-	-	-	2	-	12	-	3
-	-	-	-	1	-	-	-	1	-	1	-	4	-	-
-	-	-	-	-	-	-	-	1	-	-	-	4	-	-
-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
-	-	-	-	-	-	-	-	4	-	-	-	4	2	-
1	-	-	-	-	-	-	-	-	-	-	-	2	2	-
2	-	-	-	-	-	-	-	13	-	-	-	18	2	-
1	-	-	-	7	-	7	-	34	-	6	-	99	16	-
-	-	-	-	2	-	1	-	-	-	-	-	6	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	3	-	-	-	4	-	-
-	-	-	-	-	-	-	-	1	-	-	-	2	-	-
1	-	-	-	-	-	-	-	-	-	2	-	6	-	2
3	-	-	-	1	-	1	-	2	-	-	-	9	-	1
1	-	-	-	2	-	1	-	2	-	7	-	19	-	2
2	-	-	-	-	-	1	-	4	-	1	-	8	-	1
-	-	-	-	1	-	19	-	10	-	6	1	77	5	-
3	-	-	-	-	-	1	-	4	-	9	-	19	-	-
2	-	-	2	1	-	1	-	9	-	5	-	23	38	-
2	-	-	-	-	-	1	-	-	-	8	2	31	37	2

## CONSOLIDATED SUR

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.
MUSCLES AND TENDONS, OPERATIONS ON:								
Tenorrhaphy . . . . .	3	-	-	-	3	-	2	-
Others . . . . .	1	-	1	-	1	-	-	-
RECTUM, OPERATIONS ON:								
Fistula in ano . . . . .	2	-	-	-	14	-	2	-
Hemorrhoids . . . . .	2	-	-	-	14	-	5	1
Ischiorectal abscess . . . . .	-	-	1	-	3	-	5	-
Prolapsus recti . . . . .	-	-	-	-	1	-	-	-
Others . . . . .	1	-	1	-	3	-	1	-
MISCELLANEOUS:								
Abscesses, treatment of . . . . .	70	277	14	381	118	204	116	66
Aneurism, operation for . . . . .	-	-	-	-	-	-	-	-
Blood transfusions . . . . .	-	-	-	-	-	-	-	-
Carbuncles, treatment of . . . . .	5	167	2	51	12	65	13	15
Cysts . . . . .	5	5	-	-	12	7	4	6
Elephantiasis, treatment of . . . . .	-	-	-	-	-	-	-	-
Fistulous tracts . . . . .	-	-	-	-	6	-	6	-
Lumbar punctures . . . . .	-	-	5	-	-	-	-	-
Nails, extirpation of . . . . .	1	3	-	-	1	9	1	8
Neoplasm, excision of, benign . . . . .	-	-	-	-	1	-	3	2
Neoplasm, excision of, malignant . . . . .	-	-	-	-	-	-	-	1
Plastic operations for severe injuries . . . . .	-	-	-	-	-	-	-	-
Plastic operations for effects of disease . . . . .	-	-	-	-	-	-	-	-
Plastic operations for congenital defect . . . . .	-	-	-	-	-	-	-	1
Removal of foreign body . . . . .	3	3	3	23	1	2	2	10
Skin graft . . . . .	-	-	-	-	-	-	7	-
Snake bite, treatment of . . . . .	-	-	5	-	-	-	5	3
Thyroidectomy . . . . .	-	-	-	-	3	-	-	-
Ulcers, treatment of . . . . .	47	111	18	841	6	-	16	51
Varicose veins, treatment of . . . . .	-	3	-	-	1	-	-	1
Wounds, gunshot . . . . .	1	3	5	-	6	1	19	2
Wounds, scalds and burns . . . . .	13	62	1	8	-	-	6	32
Wounds, stab . . . . .	2	1	1	2	-	-	29	6
Wounds, others . . . . .	335	1,464	26	294	6	7	125	150
Various other minor operations . . . . .	-	-	14	207	5	3	62	67
Various other major operations . . . . .	-	-	-	-	1	-	-	1
EAR, OPERATIONS ON:								
Abscess, incision of . . . . .	-	-	-	4	2	-	-	-
Mastoid operations . . . . .	-	-	-	-	-	-	-	-
Paracentesis of membrane tympani . . . . .	-	-	1	-	-	-	-	2
Removal of foreign body . . . . .	2	3	-	15	-	-	1	5
Others . . . . .	-	-	1	-	-	-	1	-
EYE, OPERATIONS ON:								
Abscess, incision of . . . . .	-	-	-	1	1	-	2	1
Cataract, extraction of . . . . .	-	-	-	-	-	-	-	-
Chalazion, excision of . . . . .	-	-	-	-	-	1	-	-
Enucleation . . . . .	3	-	-	-	3	-	-	-
Hordeolum . . . . .	-	-	-	5	-	2	-	1
Iridectomy . . . . .	-	-	-	-	-	-	1	-
Lid operations . . . . .	-	-	-	3	-	1	1	1
Pterygium, excision of . . . . .	-	1	-	-	-	-	2	-
Pterygium, transplantation of . . . . .	-	-	-	-	1	-	-	-
Removal of foreign body . . . . .	16	37	-	16	-	25	-	5
Trachoma . . . . .	-	1	-	-	-	-	-	-
Others . . . . .	-	-	-	-	-	-	3	5
NOSE AND THROAT, OPERATIONS ON:								
Adeno-tonsillectomy . . . . .	2	-	-	1	1	-	-	-
Peritonsillar abscess, incision of . . . . .	-	1	-	-	6	-	2	-



## L REPORT—Continued

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Totals		Post-Operative Deaths
sp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	
-	-	-	-	-	-	10	-	2	-	3	-	23	-	1
-	-	-	-	-	-	-	-	-	-	-	-	3	1	1
1	-	-	-	-	-	3	-	2	-	2	-	26	-	-
-	-	1	3	7	-	2	-	2	-	2	-	36	4	-
-	-	-	1	-	-	1	-	-	-	1	-	11	1	-
-	-	-	-	-	-	-	-	-	-	1	-	2	-	-
-	-	-	-	3	-	-	-	1	-	-	-	10	-	1
2	79	3	86	21	7	40	262	150	37	220	126	814	1,525	-
-	-	-	-	-	-	-	-	1	-	-	-	1	-	-
5	-	-	-	-	-	-	-	1	-	2	-	4	5	-
1	-	-	4	2	1	8	13	6	3	11	2	60	322	-
-	-	-	-	1	-	1	-	4	-	3	3	35	21	-
-	-	-	-	-	-	-	-	-	-	-	1	-	1	-
-	-	-	-	-	-	-	-	2	-	-	-	16	-	-
-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
-	-	-	8	-	-	-	2	6	-	1	2	10	32	-
-	-	-	-	-	-	6	1	20	-	9	3	39	6	-
-	1	-	-	-	-	-	-	1	-	3	-	5	1	-
-	1	-	-	-	-	2	-	1	-	10	-	18	-	-
-	-	-	-	1	-	-	-	-	-	1	-	1	1	-
-	-	-	-	-	-	2	-	-	-	2	-	5	1	-
-	-	-	4	1	3	-	14	5	6	7	4	22	69	-
-	-	-	-	-	-	1	-	-	-	11	-	22	-	-
-	-	-	-	-	-	-	-	-	-	1	1	11	4	-
-	-	-	-	-	-	2	-	-	-	-	-	5	-	-
196	-	33	1	-	-	19	102	7	63	142	1	382	1,398	-
-	-	-	-	-	-	-	1	-	-	-	-	2	5	-
10	-	-	1	1	-	9	-	21	46	22	-	86	62	1
11	-	-	1	-	-	9	54	1	6	11	2	41	176	-
18	-	-	1	1	-	-	8	20	58	6	-	76	94	1
68	1	55	14	8	422	1,215	23	56	159	19	1,116	3,336	1	-
46	-	2	177	30	2	3	16	59	44	19	321	436	-	-
-	-	-	1	-	-	-	-	-	1	-	-	3	1	-
-	-	-	2	-	-	1	-	-	-	7	2	10	8	-
-	-	-	-	-	-	-	-	1	-	-	-	1	-	-
-	-	-	-	-	-	-	-	-	-	1	2	2	4	-
-	-	-	7	-	1	-	4	3	23	2	-	8	58	-
21	-	-	-	-	-	-	-	-	-	-	-	27	21	-
-	-	-	2	-	-	-	-	-	-	-	1	3	5	-
-	-	-	-	3	-	2	-	4	-	9	47	18	47	-
-	-	-	-	-	-	-	-	4	-	-	2	4	3	-
-	-	-	-	-	-	2	-	1	-	4	1	15	1	-
-	-	-	1	-	-	-	-	-	-	2	2	2	11	-
-	-	-	-	-	-	-	-	-	-	9	-	10	-	-
-	-	-	1	-	-	-	-	4	-	-	14	6	19	-
-	-	-	1	-	1	-	-	2	-	1	-	7	1	-
-	-	-	-	2	-	-	-	9	-	-	64	10	66	-
1	-	7	-	1	13	99	17	8	1	13	47	212	-	-
-	-	-	-	-	-	4	-	-	-	-	-	5	-	-
1	-	-	-	-	-	-	-	8	-	20	176	31	182	-
-	-	-	-	-	-	23	-	23	-	1	-	50	1	-
-	-	-	-	2	-	-	1	-	-	1	-	11	2	-

## CONSOLIDATED SUR

	Banes Division		Chiriqui Land Co.		Colombia Division		Costa Rica Division	
	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.
NOSE AND THROAT, OPERATIONS ON—Concluded:								
Removal of polypi. . . . .	—	—	—	—	—	—	—	2
Sinus operations. . . . .	—	—	—	1	—	—	2	—
Tonsillectomy . . . . .	2	12	—	—	12	—	25	—
Tracheotomy . . . . .	—	—	—	—	—	—	—	—
Turbinectomy. . . . .	—	—	—	—	—	—	—	—
Others. . . . .	—	—	—	—	—	2	—	1
SUB-TOTALS. . . . .	745	2,220	175	1,956	699	337	700	473
Injections, intravenous . . . . .	68	119	95	615	1,242	356	2,705	611
Tooth extractions . . . . .	31	51	2	164	37	101	49	33
Vaccinations . . . . .	—	10,289	—	926	—	—	53	165
TOTALS . . . . .	844	12,679	272	3,661	1,978	794	3,507	1,282

CAL REPORT—*Concluded*

Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Truxillo Railroad		Totals		Post-Operative Deaths
Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	Hosp.	Hosp. Disp.	
-	-	-	-	1	-	4	-	-	-	-	1	5	3	-
-	-	-	-	-	-	-	-	-	-	-	-	2	2	-
11	-	-	-	17	-	22	-	1	-	2	-	92	12	-
1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
-	-	-	-	2	-	-	-	-	-	-	-	2	-	-
-	-	-	-	-	-	1	1	-	-	2	1	3	5	-
373	457	8	239	422	54	1,096	1,810	778	379	986	529	5,982	8,454	86
23	268	1	-	493	2,522	436	87	818	263	310	178	6,191	5,019	-
71	57	-	66	54	48	30	256	21	17	66	164	361	957	-
-	-	-	1,855	5	1,386	-	-	-	2	38	1,289	96	15,912	-
467	782	9	2,160	974	4,010	1,562	2,153	1,617	661	1,400	2,160	12,630	30,342	86



## CONSOLIDATED

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division			
	Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.	
	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.
<b>BLOOD EXAMINATIONS:</b>																
Total examinations . .	2407	-	1450	-	1386	-	7533	-	11712	-	1096	-	8009	-	4117	-
Leucocyte enumerations . . . . .	137	-	73	-	64	-	1	-	223	-	14	-	272	-	47	-
Differential leucocyte counts . . . . .	1	-	5	-	13	-	3	-	107	-	14	-	47	-	27	-
Erythrocyte enumerations . . . . .	15	-	99	-	29	-	5	-	18	-	6	-	35	-	32	-
Hemoglobin estimations . . . . .	10	-	91	-	185	-	151	-	5484	-	477	-	3389	-	367	-
Malaria:	2204	-	1175	-	1093	-	7372	-	5784	-	562	-	4100	-	3631	-
(a) Estivo-autumnal . . . . .	-	294	-	80	-	308	-	1311	-	978	-	17	-	815	-	37
(b) Tertian . . . . .	-	4	-	1	-	148	-	542	-	251	-	16	-	73	-	6
(c) Quartan . . . . .	-	3	-	-	-	9	-	6	-	17	-	-	-	9	-	-
(d) Mixed infection . . . . .	-	-	-	-	-	2	-	-	-	14	-	1	-	22	-	-
Filaria . . . . .	1	-	1	1	1	1	1	1	-	-	-	-	19	14	4	-
Sugar . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Widal tests . . . . .	39	19	5	1	-	-	-	-	66	15	7	1	115	22	2	-
Other examinations . .	-	-	1	-	1	-	-	-	30	-	16	-	32	5	7	-
<b>URINE EXAMINATIONS:</b>																
Total examinations . .	1860	-	616	-	981	-	217	-	5189	-	911	-	4503	-	829	-
Albumin . . . . .	1860	337	616	99	-	495	-	74	-	1724	-	178	-	2022	-	23
Casts . . . . .	1860	70	616	15	-	359	-	53	-	1863	-	134	-	1532	-	13
Pus . . . . .	1860	153	616	58	-	187	-	40	-	1712	-	306	-	3691	-	57
Blood . . . . .	1860	32	616	11	-	47	-	6	-	1566	-	191	-	129	-	1
Sugar . . . . .	1860	12	616	24	-	5	-	6	-	10	-	14	-	159	-	1
Hemoglobin . . . . .	1860	12	-	-	-	16	-	3	-	4	-	-	-	33	1	-
Gonococci . . . . .	-	-	-	-	-	-	-	-	2	2	-	2	4	1	2	-
B. tuberculosis . . . . .	-	-	-	-	-	-	-	-	1	-	-	-	6	3	-	-
Other examinations . .	1860	8	616	6	-	3	-	-	170	125	25	6	-	120	-	-
<b>SPUTUM EXAMINATIONS:</b>																
Total examinations . .	55	-	16	-	42	-	10	-	499	-	75	-	1024	-	42	-
B. tuberculosis . . . . .	55	18	16	-	42	7	10	2	-	81	-	30	-	87	-	-
Pus . . . . .	55	1	16	1	-	-	-	-	-	492	-	72	-	1014	-	1
Blood . . . . .	55	1	16	1	-	-	-	-	-	36	-	4	-	70	-	-
Other examinations . .	-	-	-	-	-	-	-	-	1	-	2	-	1	1	-	-
<b>STOOL EXAMINATIONS:</b>																
Total examinations . .	1685	-	530	-	798	-	154	-	1814	-	492	-	3869	-	414	-
Uncinaria . . . . .	1685	224	530	25	-	341	-	74	-	1045	-	55	-	1496	-	2
Trichuris . . . . .	1685	293	530	177	-	147	-	46	-	575	-	88	-	886	-	9
Ascaris . . . . .	1685	211	530	86	-	100	-	30	-	374	-	31	-	545	-	5
Oxyuris vermicularis .	1685	3	530	6	-	-	-	-	-	-	-	1	-	4	-	-
Strongyloides stercoralis . . . . .	1685	29	530	9	-	57	-	11	-	90	-	30	-	290	-	-
Tenia saginata . . . . .	1685	1	530	1	-	-	-	-	-	-	-	1	-	5	-	-
Tenia solium . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other tape-worms . . . . .	-	-	-	-	-	-	-	-	-	7	-	3	-	8	-	-
Entameba histolytica .	45	17	13	5	-	3	-	1	-	694	-	249	-	136	-	4
Other entamebae . . . . .	27	7	25	14	-	1	-	-	-	114	-	29	-	279	-	2
Balantidium coli . . . . .	13	10	10	5	-	-	-	-	-	13	-	-	-	11	-	-
Flagellates, intestinal .	13	3	4	4	-	1	-	1	-	468	-	134	-	295	-	6
Blood . . . . .	28	24	7	3	-	-	-	-	-	188	-	56	-	129	-	5
Pus . . . . .	28	18	7	2	-	-	-	-	-	176	-	47	-	149	-	5
Other examinations . .	2	-	1	1	-	-	-	-	-	-	1	-	-	250	-	4
<b>MISCELLANEOUS SMEARS:</b>																
Total examinations . .	21	-	20	-	62	-	97	-	150	-	184	-	370	-	137	-
Eye . . . . .	6	-	1	-	-	-	7	-	13	11	6	5	15	5	-	-

## LABORATORY REPORT

Guatemala Division				Jamaica Division				Panama Division				Preston Division				Tela Railroad				Truxillo Railroad				
Hosp.	Hosp. Disp.			Hosp.	Hosp. Disp.			Hosp.	Hosp. Disp.			Hosp.	Hosp. Disp.			Hosp.	Hosp. Disp.			Hosp.	Hosp. Disp.			
Total Pos.	Total Pos.			Total Pos.	Total Pos.			Total Pos.	Total Pos.			Total Pos.	Total Pos.			Total Pos.	Total Pos.			Total Pos.	Total Pos.			
93	-	3453	-	16	-	40	-	5469	-	3563	-	2987	-	4137	-	6349	-	4899	-	6709	-	1217	-	
95	-	-	-	5	-	6	-	155	-	65	-	240	-	8	-	412	-	220	-	292	-	27	-	
95	-	-	-	5	-	7	-	281	-	129	-	101	-	12	-	188	-	75	-	292	-	24	-	
92	-	-	-	-	-	2	-	55	-	63	-	37	-	10	-	16	-	11	-	131	-	7	-	
95	-	-	-	-	-	3	-	1782	-	164	-	154	-	40	-	356	-	323	-	143	-	18	-	
90	-	3453	-	6	-	22	-	2953	-	3025	-	2437	-	4066	-	5247	-	4219	-	5849	-	1141	-	
-	577	-	414	-	3	-	4	-	483	-	506	-	216	-	988	-	1316	-	529	-	1415	-	156	-
-	267	-	285	-	-	-	10	-	34	-	40	-	24	-	131	-	195	-	207	-	241	-	55	-
-	22	-	7	-	-	-	-	-	20	-	14	-	1	-	6	-	32	-	28	-	27	-	2	-
-	99	-	49	-	-	-	-	-	15	-	7	-	-	-	-	-	23	-	22	-	76	-	3	-
-	-	-	-	-	-	-	-	194	-	101	-	3	2	1	-	-	-	-	-	-	-	-	-	-
59	10	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	5	-	-	-	-	-	-	13	5	-	-	7	5	-	-	114	18	29	4	-	-	-	-	-
51	15	-	-	-	-	-	-	35	-	16	-	8	-	-	-	16	-	22	-	2	-	-	-	-
39	-	211	-	18	-	801	-	3449	-	788	-	2419	-	622	-	5141	-	1223	-	4152	-	588	-	-
-	697	-	34	8	5	326	42	3449	1707	788	185	-	569	-	121	-	1208	-	144	-	1585	-	124	-
-	498	-	19	1	-	7	4	3449	583	788	124	-	242	-	30	-	906	-	93	-	501	-	37	-
-	774	-	54	-	-	12	11	3449	3202	788	698	-	475	-	80	-	730	-	204	-	3028	-	456	-
-	47	-	3	3	1	7	-	3449	90	788	6	-	103	-	17	-	178	-	34	-	659	-	63	-
-	19	-	12	3	-	294	13	580	128	54	24	-	16	-	6	-	9	-	9	-	1	-	-	-
-	62	-	2	-	-	-	-	333	12	-	-	-	2	-	-	-	11	-	-	-	49	-	-	-
-	-	-	-	-	-	-	-	20	1	3	-	-	-	-	-	-	11	-	14	-	-	-	1	-
-	2	-	-	-	-	-	-	11	-	2	-	-	-	-	-	-	5	-	1	-	-	-	-	-
57	49	-	-	3	3	155	28	211	126	68	47	11	6	3	3	-	40	-	4	-	366	-	30	-
52	-	26	-	2	-	10	-	118	-	12	-	130	-	13	-	598	-	171	-	471	-	5	-	-
-	72	-	-	2	-	10	3	118	6	12	2	-	31	-	3	598	103	171	33	-	121	-	3	-
-	60	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
-	61	-	-	-	-	-	1	-	-	-	-	-	11	-	-	-	-	-	-	-	8	-	-	-
-	32	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
73	-	203	-	4	-	62	-	1859	-	414	-	413	-	121	-	4340	-	1305	-	4056	-	117	-	-
-	1021	-	51	-	-	48	2	1859	326	414	67	-	78	-	20	-	1788	-	216	-	2366	-	42	-
-	683	-	36	-	-	-	-	1859	429	414	137	-	67	-	34	-	1831	-	600	-	1920	-	60	-
-	555	-	57	-	-	-	5	1859	114	414	32	-	23	-	10	-	1727	-	482	-	905	-	40	-
-	12	-	-	-	-	-	-	1859	1	414	1	-	-	-	3	-	5	-	-	-	2	-	4	-
-	146	-	6	-	-	-	-	1859	26	414	-	-	17	-	3	-	193	-	47	-	-	-	-	-
-	5	-	-	-	-	-	-	1859	-	414	-	-	3	-	-	-	14	-	3	-	-	-	-	-
-	6	-	-	-	-	-	-	1859	-	414	-	-	-	-	-	-	-	-	-	-	1	-	-	-
-	-	-	-	-	-	-	-	1859	-	414	-	-	-	-	-	-	6	-	4	-	1	-	-	-
-	69	-	1	-	-	-	-	54	13	49	1	-	10	-	-	-	214	-	56	-	46	-	1	-
-	19	-	1	-	-	1	-	1859	-	351	-	-	7	-	1	-	635	-	91	-	-	-	-	-
-	8	-	4	-	-	-	-	1859	1	351	-	-	2	-	-	-	13	-	2	-	4	-	-	-
-	117	-	13	-	-	-	-	1660	16	349	-	-	12	-	2	-	404	-	115	-	-	-	-	-
-	117	-	3	4	3	6	1	1859	29	413	6	-	38	-	4	-	174	-	48	-	350	-	4	-
-	288	-	8	-	-	-	-	1859	42	413	15	-	37	-	4	-	101	-	31	-	349	-	4	-
-	7	-	-	-	-	7	3	-	-	-	-	13	4	-	-	-	598	-	204	-	122	-	4	-
66	-	88	-	-	-	3	-	45	-	26	-	23	-	17	-	177	-	439	-	114	-	82	-	-
39	27	-	-	-	-	-	-	1	1	1	1	-	-	-	-	55	27	53	31	6	3	6	3	-

## CONSOLIDATE

	Banes Division				Chiriqui Land Co.				Colombia Division				Costa Rica Division			
	Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.	
	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.	Total	Pos.
<b>MISCELLANEOUS SMEARS</b>																
—Concluded																
Throat . . . . .	1	—	1	—	—	—	1	—	4	3	8	6	9	4	—	—
Gums and mouth . .	—	—	—	—	—	—	4	—	4	3	3	1	8	4	—	—
Nose . . . . .	—	—	1	1	—	—	—	—	6	—	11	1	22	3	—	—
Ear . . . . .	—	—	—	—	—	—	—	—	1	—	1	1	1	—	—	—
Genital source (gonococcus) . . . . .	13	—	17	1	43	15	69	32	42	24	109	36	150	109	—	—
Cutaneous ulcer . . .	—	—	—	—	19	—	16	—	55	23	12	5	135	83	—	—
Other smears . . . .	1	—	—	—	—	—	—	—	25	12	34	6	30	7	—	—
<b>EXAMINATION FOR SYPHILIS:</b>																
Total examinations . .	90	—	111	—	367	—	392	—	2208	—	1088	—	965	—	362	—
Complement fix. test (blood) . . . . .	—	—	—	—	—	—	—	—	1055	433	528	169	736	211	—	—
Flocculation test (blood) . . . . .	89	36	111	28	365	99	390	125	1042	493	529	174	222	114	—	—
Dark-field examination . . . . .	—	—	—	—	2	2	2	1	5	1	25	4	5	—	—	—
Spinal-fluid test . .	1	1	—	—	—	—	—	—	30	5	2	—	2	1	—	—
Other examinations . .	—	—	—	—	—	—	—	—	76	6	4	—	—	—	—	—
<b>CULTURES:</b>																
Total examinations . .	6	—	—	—	—	—	—	—	176	—	22	—	300	—	20	—
Blood . . . . .	2	1	—	—	—	—	—	—	61	10	1	—	123	19	—	—
Urine . . . . .	—	—	—	—	—	—	—	—	26	10	2	1	63	1	—	—
Sputum . . . . .	—	—	—	—	—	—	—	—	—	—	—	—	4	2	—	—
Stool . . . . .	4	—	—	—	—	—	—	—	54	5	5	2	95	6	—	—
Fluid from joint . . .	—	—	—	—	—	—	—	—	4	3	—	—	1	—	—	—
Spinal fluid . . . . .	—	—	—	—	—	—	—	—	4	—	—	—	4	—	—	—
Pleural fluid . . . . .	—	—	—	—	—	—	—	—	4	—	—	—	3	—	—	—
Throat . . . . .	—	—	—	—	—	—	—	—	3	1	4	1	2	—	—	—
Other sources . . . .	—	—	—	—	—	—	—	—	20	15	10	9	5	2	—	—
Autopsy sources . . .	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<b>MISCELLANEOUS:</b>																
Total examinations . .	1	—	—	—	4	—	—	—	32	—	19	—	44	—	—	—
Autopsies performed .	1	—	—	—	2	—	—	—	1	—	4	—	19	—	—	—
Surgical tissues reported . . . . .	—	—	—	—	—	—	—	—	5	—	—	—	8	—	—	—
Reports of progress on special problems . .	—	—	—	—	—	—	—	—	22	—	—	—	—	—	—	—
Number of x-ray examinations . . .	27	—	8	—	—	—	—	—	314	—	146	—	488	—	—	—
Other examinations . .	—	—	—	—	2	—	—	—	26	2	15	—	17	1	—	—



LABORATORY REPORT—*Concluded*

Guatemala Division				Jamaica Division				Panama Division				Preston Division				Tela Railroad				Truxillo Railroad			
Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.		Hosp.		Hosp. Disp.	
Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.	Total Pos.
24	7	-	-	-	-	-	-	5	2	2	1	-	-	1	1	2	-	6	3	-	-	1	-
1	1	-	-	-	-	-	-	2	1	2	1	-	-	-	-	2	2	5	2	2	1	-	-
8	2	-	-	-	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	1	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	2	2	1	1	-	-
43	198	88	38	-	-	3	3	25	5	21	7	6	2	14	9	91	21	352	89	57	40	75	38
35	20	-	-	-	-	-	-	12	4	-	-	5	-	-	-	24	9	21	13	4	1	-	-
14	8	-	-	-	-	-	-	-	-	-	-	4	2	2	2	3	1	-	-	43	26	-	-
99	-	107	-	-	-	-	-	648	-	824	-	387	-	252	-	1990	-	1031	-	625	-	171	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	234	107	33	-	-	-	-	578	212	824	277	386	131	251	53	1983	360	1027	206	624	90	168	34
26	18	-	-	-	-	-	-	-	-	-	-	1	1	1	1	2	-	4	1	-	-	3	1
13	6	-	-	-	-	-	-	70	22	-	-	-	-	-	-	5	-	-	-	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	8	-	-	-	3	-	-	-	170	-	102	-	7	-	2	-
11	8	-	-	-	-	-	-	4	-	-	-	3	1	-	-	75	14	28	1	3	1	-	-
-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	33	25	3	3	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	42	8	25	1	-	-	-	-
8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
16	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	3	38	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	8	5	3	2	2	1
11	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
9	-	16	-	-	-	-	-	161	-	3	-	36	-	-	-	38	-	2	-	62	-	-	-
19	-	-	-	-	-	-	-	7	-	2	-	14	-	-	-	23	-	-	-	53	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	16	-	-	-	7	4	2	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03	-	-	-	-	-	-	-	474	-	33	-	304	-	-	-	668	-	-	-	344	-	-	-
-	-	16	8	-	-	-	-	153	55	1	-	6	-	-	-	8	2	-	-	9	-	-	-

## NUMBER AND CLASSIFICATION OF X-RAY EXAMINATIONS\*

Nature of Examination	Bancs Division	Chiriqui Land Co.	Colombia Division		Costa Rica Division		Guatemala Division		Jamaica Division		Panama Division		Preston Division		Tela Railroad		Trusillo Railroad		Totals*
			Examinations	Plates and Films Used	Examinations	Plates and Films Used	Examinations	Plates and Films Used	Examinations	Plates and Films Used	Examinations	Plates and Films Used	Examinations	Plates and Films Used	Examinations	Plates and Films Used	Examinations	Plates and Films Used	
Vertebral column . . . .	-	-	12	17	18	19	18	19	-	-	5	5	10	10	5	?	8	9	66
Skull . . . . .	-	-	38	42	24	27	24	27	-	-	3	4	2	2	5	?	15	23	139
Sternum . . . . .	-	-	1	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	6
Ribs . . . . .	-	-	44	57	22	23	22	23	-	-	-	-	2	2	5	?	17	18	147
Upper limbs . . . . .	13	-	49	62	148	175	148	175	-	-	63	66	77	77	58	?	50	53	540
Lower limbs . . . . .	7	-	98	133	138	162	138	162	-	-	60	66	85	92	49	?	78	93	646
Neck . . . . .	1	-	-	-	8	9	8	9	-	-	14	15	1	1	-	-	2	2	28
Teeth . . . . .	1	-	23	53	29	160	29	160	-	-	51	52	17	17	2	?	14	26	198
Heart . . . . .	1	-	9	9	34	34	34	34	-	-	115	3	2	2	247	?	5	5	451
Lungs . . . . .	10	-	89	97	208	216	208	216	-	-	119	43	89	94	269	?	46	47	870
Liver . . . . .	-	-	6	7	2	3	2	3	-	-	9	9	-	-	-	-	6	17	36
Spleen . . . . .	-	-	1	1	4	4	4	4	-	-	-	-	-	-	-	-	-	6	6
Kidney . . . . .	-	-	14	18	24	30	24	30	-	-	12	12	4	5	8	?	-	-	70
Gastrointestinal tract .	-	-	34	42	12	11	32	92	-	-	50	21	12	21	18	?	6	24	211
Pelvic organs . . . . .	-	-	8	9	6	8	6	8	-	-	6	6	15	16	2	?	8	10	79
Miscellaneous . . . . .	2	-	34	35	5	5	5	5	-	-	-	-	2	3	-	-	89	-	45
TOTALS . . . . .	35	37	460	584	703	968	703	968	-	-	507	302	304	342	668	?	344	327	3,509

\* NOTE.—The figures appearing in the "Totals" column, under the heading "Plates and Films Used," are incomplete, inasmuch as the Tela Railroad Company's Medical Department has not supplied data in their reports to record the number of plates and films used in the Tela Hospital in examining the respective organs. Fluoroscopic examinations are included in the columns entitled "Number of Examinations." No x-ray apparatus has been installed in the Chiriqui Land Company's Hospital, nor in the Jamaica Division.

## METEOROLOGICAL REPORT

## AVERAGE TOTAL RAINFALL (INCHES)

MONTH:	Banes Division	Chiriqui Land Co.	Colombia Division	Costa Rica Division	Guatemala Division	Jamaica Division	Panama Division	Preston Division	Tela Railroad	Trunillo Railroad	Average for All Divisions
January . . . . .	1.20	.50	.00	2.49	5.02	4.06	2.48	1.68	5.05	5.16	2.76
February . . . . .	.07	1.04	.00	2.11	1.79	1.17	2.45	.13	.35	2.09	1.12
March . . . . .	.56	.82	.80	5.71	1.18	3.92	4.30	.47	.53	1.05	1.93
April . . . . .	1.57	2.80	1.89	6.82	1.50	1.49	8.02	1.90	1.84	1.06	2.89
May . . . . .	1.16	12.75	3.31	17.29	12.25	2.39	13.90	1.03	7.77	6.47	7.83
June . . . . .	4.93	9.27	6.27	11.85	12.32	1.85	5.66	4.37	8.94	8.54	7.40
July . . . . .	1.23	9.27	3.36	13.62	10.02	2.84	13.02	1.60	6.82	9.10	7.09
August . . . . .	7.14	8.95	4.39	3.31	12.48	7.20	3.65	4.49	8.93	6.06	6.66
September . . . . .	2.13	16.01	5.28	8.68	9.49	5.69	6.72	2.99	7.69	9.42	7.41
October . . . . .	6.66	13.81	15.76	13.65	13.89	8.41	5.93	7.40	9.73	15.78	11.10
November . . . . .	4.07	9.95	2.95	14.90	10.09	4.70	11.71	3.53	6.27	8.48	7.67
December . . . . .	3.66	4.52	.00	8.80	11.60	3.21	8.05	2.11	11.96	16.84	7.08
TOTALS . . . . .	34.38	89.69	44.01	109.23	101.63	46.93	85.89	31.70	75.88	90.05	70.94

## MEAN TEMPERATURE (FAHRENHEIT)

MONTH:	Banes Division	Chiriqui Land Co.	Colombia Division	Costa Rica Division	Guatemala Division	Jamaica Division	Panama Division	Preston Division	Tela Railroad	Trunillo Railroad	Average for All Divisions
January . . . . .	70.00	79.50	78.50	70.50	76.50	73.00	78.50	71.50	75.00	75.50	74.85
February . . . . .	69.00	76.00	80.50	71.50	75.50	75.00	77.50	71.50	78.00	78.50	75.30
March . . . . .	70.50	82.00	81.50	72.50	75.50	74.00	84.00	74.00	79.00	82.50	77.55
April . . . . .	76.00	81.00	82.50	71.00	83.50	74.00	79.00	74.00	84.00	83.50	78.85
May . . . . .	75.50	82.50	82.50	72.00	87.50	73.00	80.00	76.00	84.00	85.00	79.80
June . . . . .	77.00	81.00	81.50	75.50	83.50	75.00	80.50	77.50	82.50	81.00	79.50
July . . . . .	77.00	79.50	83.00	72.50	84.00	71.50	84.00	74.00	82.00	80.00	78.75
August . . . . .	77.50	79.50	82.50	72.00	82.50	74.00	83.50	78.00	81.50	80.50	79.15
September . . . . .	79.00	80.50	81.00	74.00	82.00	74.00	81.00	79.50	83.00	81.00	79.50
October . . . . .	77.50	77.50	81.50	74.50	80.00	73.00	81.00	76.00	75.00	79.50	77.55
November . . . . .	70.50	79.50	80.50	73.50	82.00	73.00	80.00	72.50	74.50	79.50	76.55
December . . . . .	71.50	79.00	80.00	70.50	75.00	71.50	78.50	70.00	73.00	77.50	74.65
Average maximum temperature . . . . .	95.25	95.50	94.25	93.92	97.00	89.17	92.67	95.42	99.08	95.75	94.80
Average minimum temperature . . . . .	53.25	64.08	68.33	51.08	64.25	57.67	68.58	53.67	59.50	64.92	60.53
Average mean temperature . . . . .	74.25	79.79	81.29	72.50	80.63	73.42	80.63	74.55	79.29	80.34	77.67





	Aban-garez	Atenas	Car-tago	Cas-tilla	Coppe-name	Here-dia	Irlona	Parie-mina	Sara-macca	Surl-name	Tela	Tur-rialba	Total
Number of voyages made . . .	26	25	17	12	10	17	5	17	3	9	14	26	181
Total number of officers, all voyages . . . . .	500	501	341	191	194	362	79	354	56	172	220	533	3,503
Total number in crews, all voyages . . . . .	1,314	1,354	1,003	492	419	1,025	210	1,021	129	378	565	1,452	9,362
Total number of ships' laborers, all voyages . . . . .	349	296	87	144	116	184	70	133	38	78	133	276	1,904
Number of seamen given physical examination before "signing-on" . . . . .	1,334	1,340	1,001	501	429	989	223	990	132	380	584	1,403	9,306
Number of rejected applicants, "signing-on" day . . . . .	16	14	4	7	7	3	6	13	1	1	14	6	92
Number of prospective passengers rejected at tropical ports . . . . .	-	-	-	-	-	-	-	1	-	-	-	-	1
Number of cabin passengers carried . . . . .	2,304	2,689	2,408	885	668	2,706	321	2,479	209	592	937	2,805	19,003
Number of deck passengers carried . . . . .	186	283	254	27	264	226	109	290	84	176	37	312	2,248

OFFICERS, CREWS AND SHIPS'

LABORERS:

Total number of patients treated . . . . .	800
Total number of treatments in office . . . . .	1,163
Total number of treatments in quarters . . . . .	45

PASSENGERS:

Total number of patients treated . . . . .	174
Total number of treatments in office . . . . .	168
Total number of treatments in staterooms . . . . .	86

Number of vaccinations . . . .

Number of persons detained

by quarantine and immigration authorities . . . . .

\* Number of Members of crews.

of deaths (Passengers . . . . .

by quarantine and immigration authorities . . . . .

\* Number of Members of crews.

of deaths (Passengers . . . . .

by quarantine and immigration authorities . . . . .

\* Number of Members of crews.

of deaths (Passengers . . . . .

\* The deaths aboard steamships of the New Orleans Division were caused by: cerebral hemorrhage, 1; angina pectoris, 1; acute cardiac failure, 1; arteriosclerosis, 1; suicide (pistol), 1; drowning, 2.

\*CLASSIFICATION OF DISEASES TREATED ABOARD PASSENGER STEAMSHIPS AND BY PORT MEDICAL OFFICERS  
AT NEW YORK, NEW ORLEANS AND BOSTON

	Steamships N. Y. Division		Steamships N. O. Division		Port Med. Officer New York		Port Med. Officer New Orleans		Port Med. Officer Boston		Revere Sugar Refinery Boston	
	Crew	Pass.	Crew	Pass.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.	Emp.	Non- Emp.
Epidemic, endemic or infectious diseases (Charts Nos. 1 to 42, incl.).	124	36	100	29	39	-	21	-	7	-	2	-
General diseases not included above (Charts Nos. 43 to 69, incl.).	60	26	47	15	17	-	1	4	-	-	1	-
Diseases of the nervous system and of the organs of special sense (Charts Nos. 70 to 86, incl.).	185	102	114	40	72	2	41	1	41	-	395	-
Diseases of the circulatory system (Charts Nos. 87 to 96, incl.).	51	28	5	6	36	-	12	1	1	-	6	-
Diseases of the respiratory system (Charts Nos. 97 to 107, incl.).	251	80	469	94	50	-	66	1	15	-	272	-
Diseases of the digestive system (Charts Nos. 108 to 127, incl.).	380	228	1,839	417	93	-	116	1	35	-	655	-
Non-venereal diseases of the genito-urinary system and its adnexa (Charts Nos. 128 to 142, incl.).	22	10	17	17	13	-	9	2	1	-	14	-
The puerperal state (Charts Nos. 143 to 150, incl.).	-	1	-	1	-	-	-	-	-	-	-	-
Diseases of the skin and of the cellular tissue (Charts Nos. 151 to 154, incl.).	116	52	312	82	108	-	58	3	56	-	130	-
Diseases of the bones and of the organs of locomotion (Charts Nos. 155 to 158, incl.).	185	109	16	3	25	-	11	2	17	-	81	-
Malformations (Chart No. 159)	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of early infancy (Charts Nos. 160 to 163, incl.).	-	-	-	-	-	-	-	-	-	-	-	-
Old age (Chart No. 164)	-	-	-	-	-	-	-	-	-	-	-	-
External causes (Charts Nos. 165 to 203, incl.).	698	101	712	129	723	13	582	28	326	-	1,659	-
Ill-defined diseases (Charts Nos. 204 and 205)	217	199	468	341	12	-	310	5	-	-	-	-
TOTALS.	2,289	972	4,099	1,174	1,188	15	1,227	48	499	-	3,215	-

\*NOTE: This table gives only cases treated, and does not show the number of treatments.

There were no cases of quarantinable diseases aboard our steamships during the year. There were 5 cases of trachoma (Chinamen in transit); 9 cases of venereal diseases among the passengers, and 102 cases of venereal diseases among members of the crews.

The chart numbers used are taken from the "International List of Causes of Sickness and Death." These chart numbers are used universally by public-health and city and state health departments and organizations.



REPORT OF PORT MEDICAL OFFICERS AND SANITARY INSPECTOR

MEDICAL AND SURGICAL CASES TREATED

Port	Medical Cases			Surgical Cases			Totals	
	No. of Cases Emp.	No. of Cases Non-Emp.	No. of Treatments	No. of Cases Emp.	No. of Cases Non-Emp.	No. of Treatments	No. of Cases	No. of Treatments
New York . . . . .	273	1	360	915	14	3,969	1,203	4,329
New Orleans . . . . .	596	19	1,084	631	29	2,152	1,275	3,236
Boston {	Long Wharf . . . . .	173	—	268	326	—	499	868
	Revere Refinery. . . . .	1,556	—	454	1,659	—	3,215	2,999
TOTALS . . . . .	2,598	20	2,166	3,531	43	9,266	6,192	11,432

PHYSICAL EXAMINATION OF PROSPECTIVE EMPLOYEES

Port	Total No. Examined	Total No. Rejected	Per Cent Rejected
New York . . . . .	933	192	20.58
New Orleans . . . . .	578	78	13.49
Boston . . . . .	329	26	7.90
TOTALS . . . . .	1,840	296	16.08

PHYSICAL EXAMINATION OF MEMBERS OF CREWS

Port	Total No. Examined	Total No. Rejected	Per Cent Rejected
New York . . . . .	13,783	106	.77
New Orleans . . . . .	10,548	121	1.15
Boston . . . . .	2,725	10	.37
TOTALS . . . . .	27,056	237	.88

PHYSICAL CAUSES FOR REJECTION OF MEMBERS OF CREWS

	New York	New Orleans	Boston		New York	New Orleans	Boston
Influenza . . . . .	1	—	—	Hernia . . . . .	22	19	5
Syphilis, primary . . . . .	—	5	—	Diseases of the urethra . . . . .	—	1	1
Syphilis, secondary . . . . .	—	1	—	Other non-venereal diseases			
Syphilis, period not specified . . . . .	8	—	1	of the male genital organs. . . . .	4	1	—
Soft chancre . . . . .	8	15	2	Scabies . . . . .	—	1	—
Gonococcal infection, except				Ulcer of the skin . . . . .	1	—	—
that of the eye . . . . .	21	67	1	Other diseases of the skin			
Follicular conjunctivitis . . . . .	—	1	—	and adnexa. . . . .	11	2	—
Other diseases of the eye or its				Traumatism by crushing			
adnexa. . . . .	5	1	—	(vehicles, etc.) . . . . .	2	—	—
Acute bronchitis . . . . .	1	—	—	Other external violence . . . . .	—	1	—
Diseases of the lymphatic				No disease; malingering . . . . .	1	—	—
system. . . . .	—	5	—	Infections of undetermined			
Diseases of the teeth and gums. . . . .	20	—	—	origin . . . . .	1	—	—
Diseases of the stomach . . . . .	—	1	—	TOTALS . . . . .	106	121	10

VACCINATIONS

New York. . . . .	293
New Orleans. . . . .	902
Boston . . . . .	27

FUMIGATION

	New York	New Orleans	Boston
Steamships fumigated throughout . . . . .	43	43	14
Holds only . . . . .	—	—	—
Superstructure only . . . . .	—	—	—
Forward quarters . . . . .	8	—	—
Aft quarters . . . . .	9	—	3
Separate rooms . . . . .	4	4	17

## EXPLANATORY NOTES

A list of abbreviations as used in the tables in Section VI—with their meanings—is given herewith:

M.—Male  
F.—Female  
T.—White persons born in temperate zones  
O.—All persons other than “white persons born in temperate zones”  
Emp.—Employee  
Non-emp.—Non-Employee  
Pass.—Passenger  
Pos.—Positive  
N. Y.—New York  
N. O.—New Orleans

Referring to the names of certain divisions which do not indicate the name of the country where located, the following explanation is given: Banes and Preston Divisions are located in Cuba; the Tela Railroad Company and the Truxillo Railroad Company in Honduras; and the Chiriqui Land Company in Panama.

The chart numbers referred to in some of the tables are taken from the “International List of the Causes of Sickness and Death.” These chart numbers are used universally by public-health and city and state health departments and organizations.

The term “Employees” includes all persons appearing on our payrolls, including laborers and others employed on a part-time or hourly basis.

The term “Non-Employees” includes all persons formerly indicated by the classifications “Members of Families of Employees” and “Other Non-Employees”—i.e., all persons not included in the term “Employees.”

It will be noted that dependents are separated into two groups—(1) White persons born in temperate zones, and (2) “Others.” The latter group includes all individuals, *irrespective of color or race*, except white people with nativity in temperate zones. This method affords an opportunity to determine the effects of climatic conditions on white people born in temperate zones and residing in a tropical climate. The term “Others” has no racial significance; and that classification includes children born in the tropics, whose parents are considered as “White persons born in temperate zones.”

The Medical Department in the Jamaica Division functions somewhat differently from those in the other Divisions. In Jamaica, employees and their dependents who are seriously ill receive treatments in hospitals operated by the Government; and in consequence the medical attention furnished by the Company consists mainly of “first aid” measures and dispensary service to persons suffering from minor ailments and injuries. For this reason, the Jamaica Division is not included in tables showing morbidity, mortality and fatality rates, disease incidence, and other vital statistics.

*Hospital Dispensaries* are clinics in charge of physicians, where ambulatory cases are given medical and surgical attention. In most instances they are in the Hospital or immediately adjoining it; but some of them are situated in outlying parts of the plantations where a large number of people are congregated.

*Field Dispensaries* are in charge of Dispensers, who are located in more or less isolated sections of the plantations. They treat minor ailments or injuries of ambulatory patients, and render first-aid treatment to more serious cases until they can be transported to the Hospital.

## SPECIAL COMMENT

The author of each paper is afforded an opportunity to give free expression to his own ideas on the subject of the article, and it is understood that he is solely responsible for the opinions expressed and the statements made therein.





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